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Phytosociology of *Atractylis cancellata* and *Micromeria microphylla* communities in southern Italy with insights on the xerothermic steno-Mediterranean grasslands high-rank syntaxa

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Abstract

In the present paper a phytosociological study on the dry grassland communities identified in the western sector of the Murgia Plateau (Murgia delle Gravine) and in the Lucanian badlands territory is presented. Forty vegetation releves were carried out using the Braun-Blanquet phytosociological approach. Two new associations characterized by a therophytic dominance, namely *Lysimachio foeminae-Atractylidetum cancellatae* and *Campanulo erini-Micromerietum microphyllae*, are described and discussed from a syntaxonomic and biogeographic viewpoint. In addition, new phytosociological data concerning the *Petrosedum ochroleucum* communities developed on limestone outcrops, the perennial *Hyparrhenia hirta* steppe-like grasslands of the low-altitude areas of the Murgia hills and the small-size *Brachypodium distachyum* therophytic communities are presented.

Keywords

biogeography, limestone pavements, Mediterranean grasslands, micro-garrigue, Murgia Plateau, syntaxonomy, therophytes

Introduction

Dry grasslands habitats are an extremely interesting and variegated element of the vegetation landscape of the hilly and montane areas of the central and southern Apennines. The bioclimatic position, intermediate between the Mediterranean and the Temperate Region, the very rich species pool available and the millennial multiform pattern of land-uses contributed to the high coenological diversification we are witnessing at present (Biondi and Blasi 1984; Biondi et al. 1995; Di Pietro 2011; Apostolova et al. 2015). The grasslands of the Murgia plateau and Gravinas gorges (an area majorly laying in the Apulia Region but comprising also territories in the administrative province of Matera in the Basilicata Region) can be distinguished from those occurring in the rest of the Apennines due to a more marked floristic and cenological similarities with the western Balkans vegetation. The situation is different as regards the grassland communities that develops on the clayey substrates subjected to accelerated erosion which appear in their typical form of Badlands (locally called "calanchi"). In that case, the vegetation shows greater similarities with what is known for the driest sectors of the Mediterranean basin characterized by the dominance of pre-desert steppe species, such as *Lygeum spartum* (Brullo et al. 1990). Over the past 20 years, the phytosociological knowledge of the study area (especially of the Murgia Plateau) was significantly improved (Forte et al 2005; Biondi and Guerra 2008; Terzi and D'Amico 2008; Di Pietro et al. 2010; Terzi et al. 2010; Di Pietro and Wagensommer 2008, 2014). Currently there is a good knowledge about the most common perennial grasslands (*Acino suaveolen-*

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tis-Stipetum austroitalicae and *Irido pseudopumilae-Scorzoneretum columnae*) and micro-garrigue associations (*Helianthemo jonii-Corydothymetum capitati*). Instead, the coenological knowledge on therophytic grasslands still shows many gaps. In fact, the syntaxonomy of perennial and therophytic grasslands remains uncertain for the higher ranks. In this paper, new phytosociological data for five community types are presented and discussed. In particular, we formalized the proposal of two new phytosociological associations of therophytic grasslands dominated by *Atractylis cancellata* and *Micromeria microphylla*, two species which exhibit a restricted distribution in the Italian peninsula. *Atractylis cancellata* (Fig. 1) is a therophyte having a Mediterranean-W-Asian distribution ranging from SW-Morocco and Canary islands (the native status of the species in these islands is still doubtful) to W-Pakistan throughout the southern sector of Iberian Peninsula, S-France, S-Italy, Sicily and Sardinia, N-E Greece and North Macedonia, Turkey, all the middle-East countries, the NE sector of the Arabian Peninsula and the coastal areas of Tunisia, Algeria, Libya and Egypt (Battandier and Trabut 1888; Pampanini 1931; Quezel and Santa 1962-63; Davis 1965-1988; Pottier-Alapetite 1979; Ozenda 1983; Benabib 2000; Boulos 2002; Fennane and Ibn Tattou 2009; López Martínez and Devesa 2014; Bammou et al. 2015; Hassler 2020; African Plant Database (version 3.4.0), Conservatoire et Jardin botaniques de la Ville de Genève and South African National Biodiversity Institute, Pretoria, "Retrieved [sept 2020]", from http://africanplantdatabase.ch). In southern Italy *Atractylis cancellata* occurs in the coastal and subcoastal areas of the Calabria Region and eastern Basilicata, in the Murgia plateau and Salento (Bartolucci et al. 2018). From an ecological point of view *A. cancellata* acts as a thermophilous species particularly resistant to drought (it occurs in the Negen and Dahna desert in Israel and Saudi-Arabia respectively) and exhibits a slight preference for neutral-alkaline soils with a significant clayey component (Pignatti et al. 2005).

Micromeria microphylla (Fig. 2) is a rare steno-Mediterranean micro-chamaephyte whose distribution range includes only Italy, Malta, Cyprus, Kriti and Lybia (Pampanini 1930; Euro+Med 2006-, Brullo et al. 2020). Additional records enlarge the distribution area of *M. microphylla* also to few localities of Spain (Balearic Islands) (Morales 1991; Castroviejo et al. 2010) and Croatia (Flora Croatica Database: https://hirc.botanic.hr/fcd/, accessed on August 2018). In Italy, *Micromeria microphylla* is known for various sites of Sicily, where it is located in the Drepano-Panormitano, Agrigentino, Camarinense and Ibleo phytogeographical districts, and for Egadi and Pelagie islands (Pignatti 1982; Brullo et al. 1995; Mazzola et al. 2001; Gueli and Lo Giudice 2004; Pasta et al. 2008). *M. microphylla* occurs also in the Apulia Region where it was recorded for the Adriatic coastal area between Andria and Otranto, and for few limestone rocky outcrops embedded in the dry grasslands of the *Hippocrepido-Stipion* near Grottaglie (Murgia Area). Further records for the Italian territory come from the archeological site of "Ostia antica" in the proximity of Rome where *M. microphylla* is considered an adventitious species (Lucchese 1988; Lucchese and Pignatti 2013).

Due to the very sporadic distribution of *Micromeria microphylla* in the Italian peninsula, this species was included in the Italian regional Red Lists and classified as "endangered" for the Apulia Region and as "low risk" for Sicily Region (Conti et al. 1997). However, the updated red list of plants of Apulia (Wagensommer et al. 2013) did not confirm the occurrence of *M. microphylla* for this Region.

Study Area

The study area (Fig. 3) encompasses two different sites. The first site concerns the western side of the Murgia plateau, an area bordering the Taranto Gulf in the Ionian side of the Apulia Region which also extends for a minor

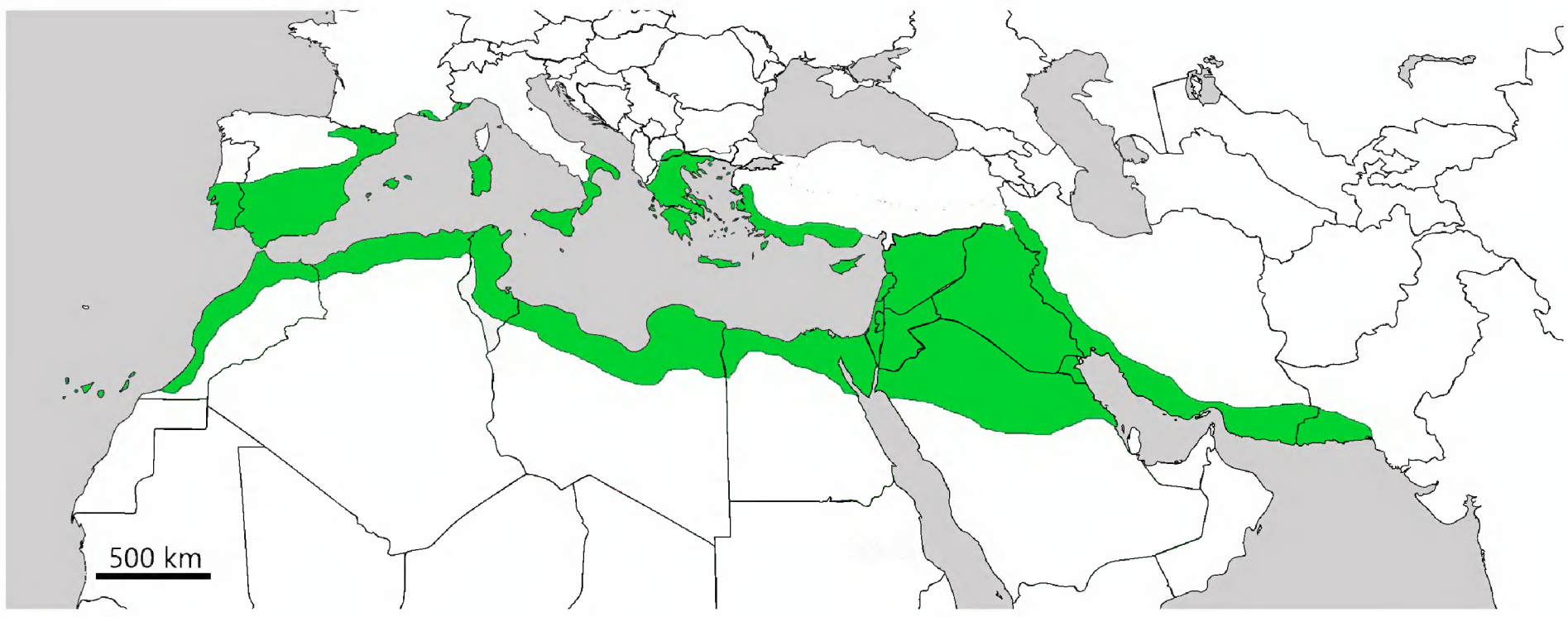

Figure 1. Distribution area of *Atractylis cancellata*.

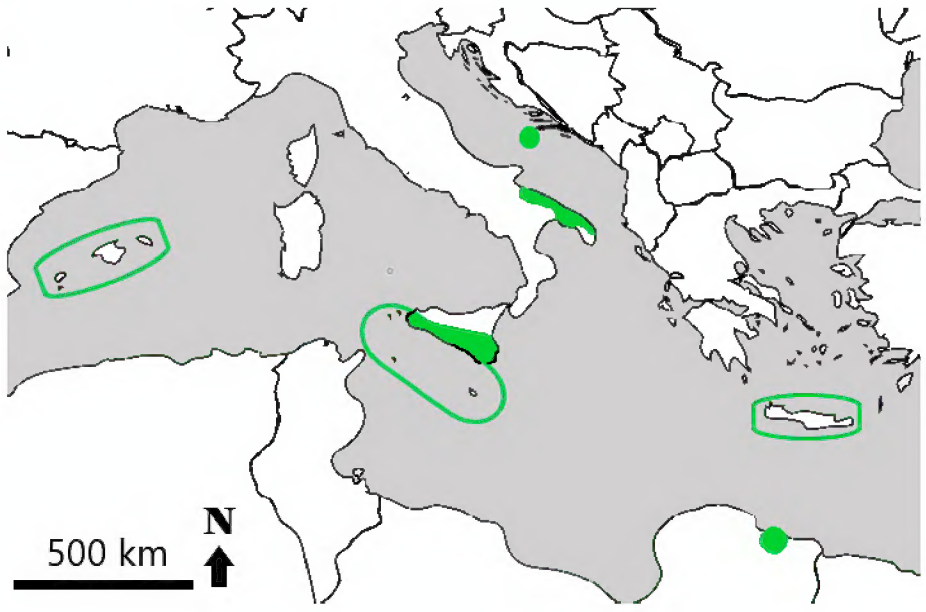

Figure 2. Distribution area of *Micromeria microphylla*.

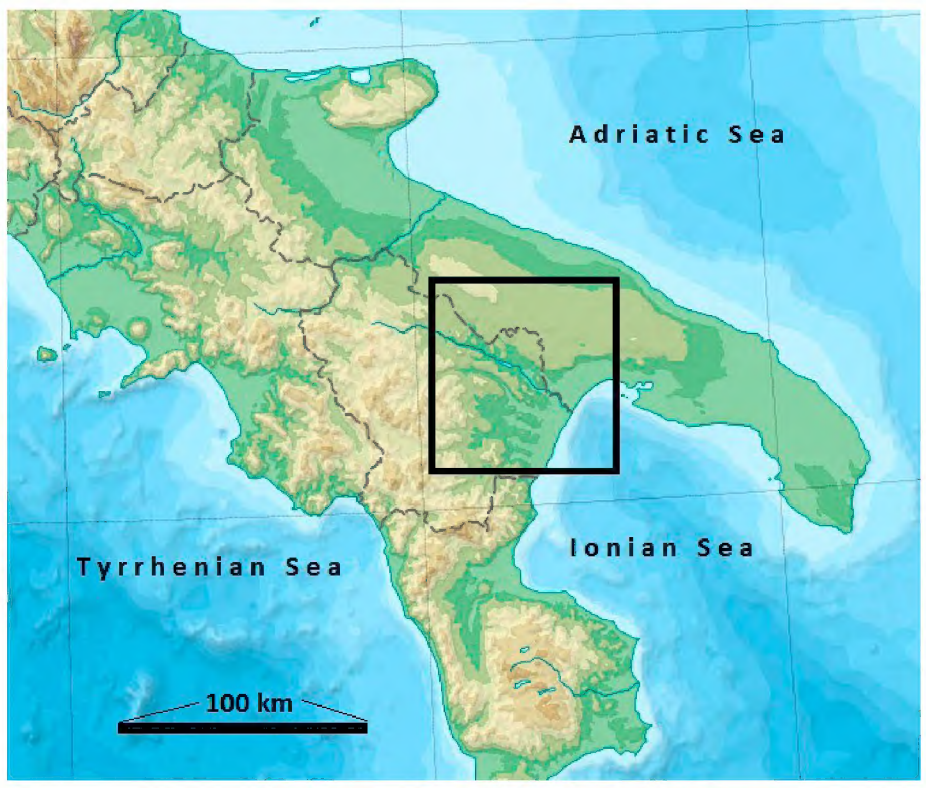

Figure 3. Study area.

part in the Basilicata administrative Region. Murgia is the local term for "stone" and, according to the geological literature, it identifies a wide geological unit composed of a large plateau originated by the fragmentation of the Mesozoic Apulian limestone platform. The highest culmination (Torre Disperata 686 m) places the Murgia in third place among the Apulian orographic system after the Daunian sub-Apennine (Mount Cornacchia 1190m) and the Gargano Promontory (Mount Calvo 1090m). The Ionian side of the Murge plateau is characterized by deep vertical gorges, locally called "Gravine". The study area extents in the colline belt of the Murgia of Gravine, with an altitude range between 200 and 450 m a.s.l. on substrates composed of Mesozoic limestones and Plio-Pleistocene calcareous sandstones. The second site is located in the south-eastern part of the Basilicata Region where a sequence of hills composed of Plio-Pleistocene marine clays (Bradanic foredeep) with interspersed sandy levels occur. These hills are in continuous rejuvenation by means of channel incisions resulting in the development of typical running water slope landforms known as "Calanchi" and "Biancane" (Patacca and Scandone 2007; Del Prete et al. 2008; Bentivenga et al. 2014).

From a bioclimatic standpoint (Fig. 4 and Fig. 5) the whole study areas ranges between the upper Meso-Mediterranean and lower Meso-Mediterranean thermotypes and between the upper dry and lower sub-humid umbrotypes (Blasi 2006). In terms of potential (zonal) vegetation the Murgia territory is characterized by different forest types ranging between *Euphorbio apii-Quercetum trojanae* of the flattish limestone plateaus, *Teucrio siculi-Quercetum trojanae* in the upper part of the Gravine gorges, *Festuco exaltatae-Carpinetum orientalis* within north-facing slopes and at the Gorges bottom and *Fraxino orni-Quercetum ilicis* within the rocky steep slopes (Bianco et al. 1988; Biondi and Guerra 2008; Di Pietro and Misano 2009). The potential vegetation of the whole Lucanian Badlands area can be broadly addressed to thermophilous *Quercus pubescens* woods (*Lauro-Quercenion pubescentis*) and Mediterranean maquis shrublands (*Helictotricho-Pistacietum lentisci*). However, if observations were made at a smaller scale, each single badland should be considered as as a single vegetation unit composed of a mosaic of permanent micro-communities. These communities are dominated, in turn, by *Lygeum spartum*, *Atriplex halimus*, *Pharapholis incurva*, *Suaeda fruticosa*, *Sulla coronaria*, *Sulla capitata*, *Polygonum tenoreanum* depending on micro-geomorphology and soil texture (Brullo et al. 1990; Corbetta et al. 1992; Di Pietro et al. 2010).

Data and Methods

During the period 2001-2018 40 relevés of grassland stands were carried out applying the phytosociological approach (Braun-Blanquet 1964; Westhoff and van der Maarel 1978). The plot size used in the sampling procedures was variable according to the sampled vegetation type (therophytic grasslands, micro-chamaephytic grasslands, hemycryptophytic grasslands). Taxonomic nomenclature follows the checklist of the Italian vascular flora by Bartolucci et al. (2018) while for identification and taxonomic classification reference were made to Pignatti et al. (2017-2019). Life form and chorological spectra were calculated only for the communities described as new in this paper and made reference to Pignatti (1982) and Pignatti et al. (2005). Three types of spectra were calculated according to: i) how many times a given corotype/life form occurred in the communities in issue (presence spectrum), ii) summing the frequency of each corotype/life form and multiplying this sum for the ratio between 100 and the number of relevés included in the phytosociological table (frequency spectrum) and iii) summing the average cover values (5 = 87.5; 4 = 62.5; 3 = 37.5; 2 = 17.5; 1 = 5; + = 1; r = 0.1) corresponding to each dominance-abundance Braun-Blanquet's cover index and multiplying this sum for the ratio between 100 and the number of relevés included in the phytosociological table (cover spectrum).

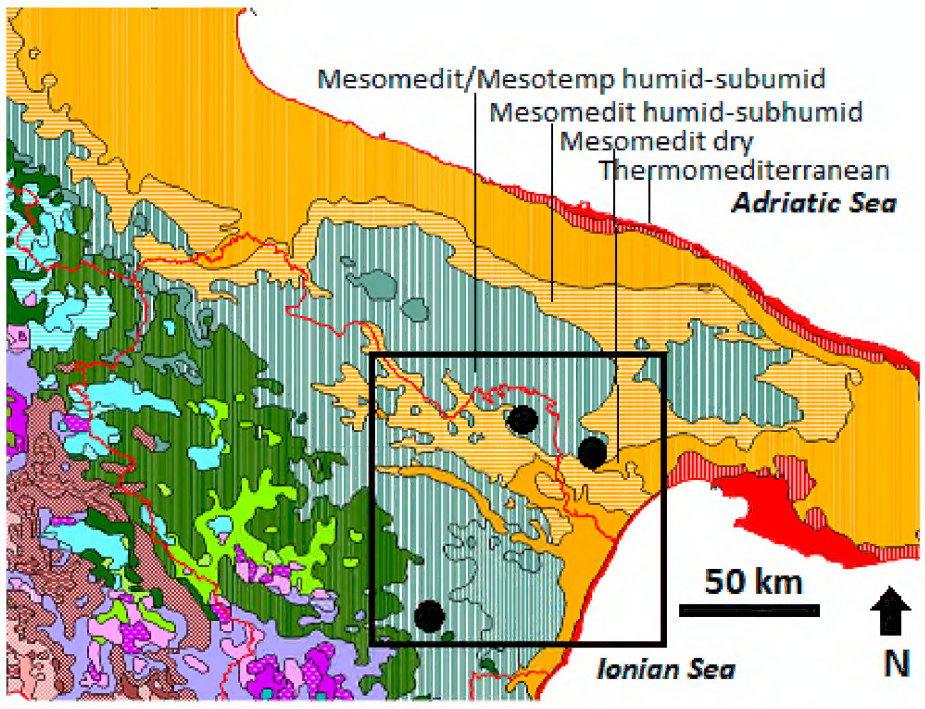

Figure 4. Geographic location of the sample sites (filled circle) and bioclimatic features of the study area (after Blasi C. 2006, modified).

In the diagnosis of each plant community we have highlighted the "dominant taxa" (species showing cover-abundance higher than 3 according to the Braun-Blanquet scale in at least one of the relevés included in the phytosociological table) and the "highly frequent taxa" (species occurring in at least the 75% of the relevés of the phytosociological table). In naming the phytosociological syntaxa, we adhered to the rules of the fourth edition of the International Code of Phytosociological Nomenclature (ICPN, Theurillat et al. 2020). The syntaxonomic classification of each single species (at the rank of class) made reference to Mucina et al. (2016) and was used to build the syntaxonomic spectra of the two associations proposed as new in this paper.

Results

The field work led to the identification of five homogeneous plant communities all referring to open dry grassland and micro-garrigue habitats. Two of them, namely *Lysymachio foeminae-Atractilidetum cancellatae* and *Campanulo erini-Micromerietum microphyllae*, are here proposed as new associations. For these latter, a detailed floristic, ecological, chorological and syntaxonomic description was provided. Two communities, out of the other three communities identified, were referred to associations (*Stipo austroitalicae-Hyparrhenietum hirtae*, *Medicago disciformis-Brachypodietum distachyi*) which were already described for the study area by other authors (Biondi and Guerra 2008), while for the third community the preliminary rank of "community type" was used (i.e. *Petrosedum ochroleucum* subsp. *mediterraneum* community).

Vegetation description

LYSYMACHIO FOEMINAE-ATRACTYLIDETUM CANCELLATAE Di Pietro, Fortini, Misano et Terzi ass. nov. *hoc loco* (Table 1)

LYSYMACHIO FOEMINAE-ATRACTYLIDETUM CANCELLATAE TYPICUM

Name - Lysymachio foeminae-Atractylidetum cancellatae typicum Di Pietro, Fortini, Misano et Terzi subass nov. *hoc loco* (*Holotypus* rel. 5, Table 1).

Characteristic taxa - Atractylis cancellata, *Helianthemum salicifolium*, *Filago eriocephala*, *Lysimachia foemina*.

Dominant taxa - Atractylis cancellata.

High frequency taxa - Atractylis cancellata, *Helianthemum salicifolium*, *Filago eriocephala*, *Lysimachia foemina*, *Hippocrepis biflora*.

Synecology - Therophytic communities colonizing the Pliocene clayey substrates of the Lucanian badlands and developed on extremely restricted areas (1–2 m² or even less). The *Lysymachio-Atractylideto typicum* (Fig. 6) acts as a poor-in-species community (average number of species per relevé = 12) which characterizes the relatively stable parts of the badland's south-facing slopes. In particular this community is located above and below the steeper part of the badland characterized by accelerated erosion and occupied by the *Camphorosmo-Lygeetum sparti* Brullo et al. 1990. In this context the *Lysymachio foeminae-Atractylidetum cancellatae* gives rise to two separated therophytic transiction fringes between the *Cam-*

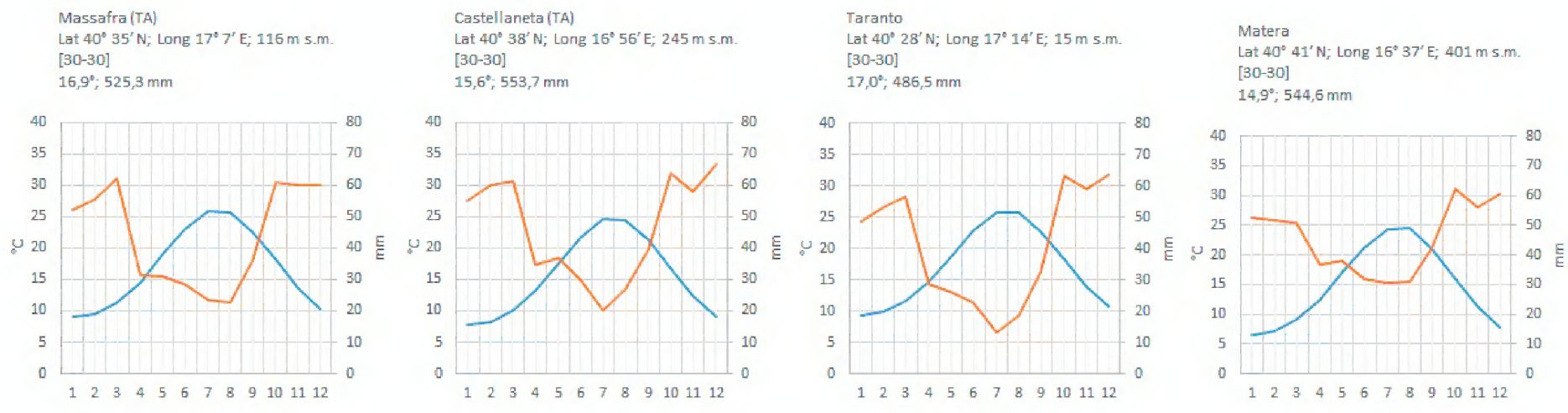

Figure 5. Thermo-pluviometric diagrams of four stations located in the proximity of the study area.

phorosmo-Lygeetum and the communities developed on its upper and lower sides. In most cases the communities developed at the upper side are those dominated by *Sulla coronaria* and *Scorpiurus muricatus* occurring at the top of each single badland unit. The communities developed at the *Camphorosmo-Lygeetum* lower side are generally dominated by *Parapholis incurva* and *Sulla capitata* these species finding their optimal conditions at the badland footslopes where the run-off waters tend to deposit the finest clays.

Life forms and chorology - Therophytes dominates in all the life forms spectra followed by the hemicryptophytes. Geophytes are completely absent and chamaephytes are very scarce. In the chorological spectrum steno-Mediterraneans dominate followed by Euro -Mediterraneans. The other chorotypes exhibit percentages always lower than 4% (Fig. 7).

Syndynamic - The *Lysimachio-Atractylidetum typicum* can be considered as a fragment of the micro-permanent vegetation mosaic forming the "badland system" micro-geosygmetum. A reduction of the erosive action of the flooding waters leads to the rapid colonization of the space occupied by the *Lysymachio foeminae-Atractylidetum cancellatae* by the communities dominated by *Sulla coronaria* (upper part of badland) or *Sulla capitata* (lower part of badland) and subsequently by the final scrub stage of the *Helictotricho convoluti-Pistacietum lentisci* Di Pietro et Misano 2010.

LYSYMACHIO FOEMINAE-ATRACTYLIDETUM CANCELLATAE ONONIDETOSUM RECLINATAE

Name - Lysymachyo foeminae-Atractylidetum cancellatae ononidetosum reclinatae Di Pietro, Fortini, Misano et Terzi subass nov. (*Holotypus*: rel. 12, Table 1).

D*ifferential taxa of subassociation - Ononis reclinata*, *Bupleurum baldense*, *Coronilla scorpioides*.

Dominant taxa - Atractylis cancellata.

High frequency taxa - Atractylis cancellata, *Helianthemum salicifolium*, *Filago eriocephala*, *Lysimachia foemina*, *Brachypodium distachyon*, *Hypochoeris achyrophorus*, *Euphorbia exigua*, *Coronilla scorpioides*, *Poa infirma*, *Crupina vulgaris*, *Helianthemum jonium*, *Fumana ericifolia*.

S*ynecology* - On the limestone substrates of the Murgia delle Gravine (in this case in the Gravina of Matera), this community features small pockets of soil interposed between the steppe-like grasslands and the micro-garrigues and the Mediterranean maquis communities. The most natural and long-lasting aspect of this subassociation develops where a very thin layer of soil covers the flat and more or less crackless limestone rocky surfaces. However, there are also other aspects related to the more or less disturbed areas placed on the edge of the paths created by grazing cattle trampling. Compared to the *Lysimachio-Atractylidetum typicum* occurring within the clayey Badlands area, the subass. *ononidetosum reclinatae* shows a significantly higher floristic richness (average number of species per relevé = 24). This is due to the wider pool

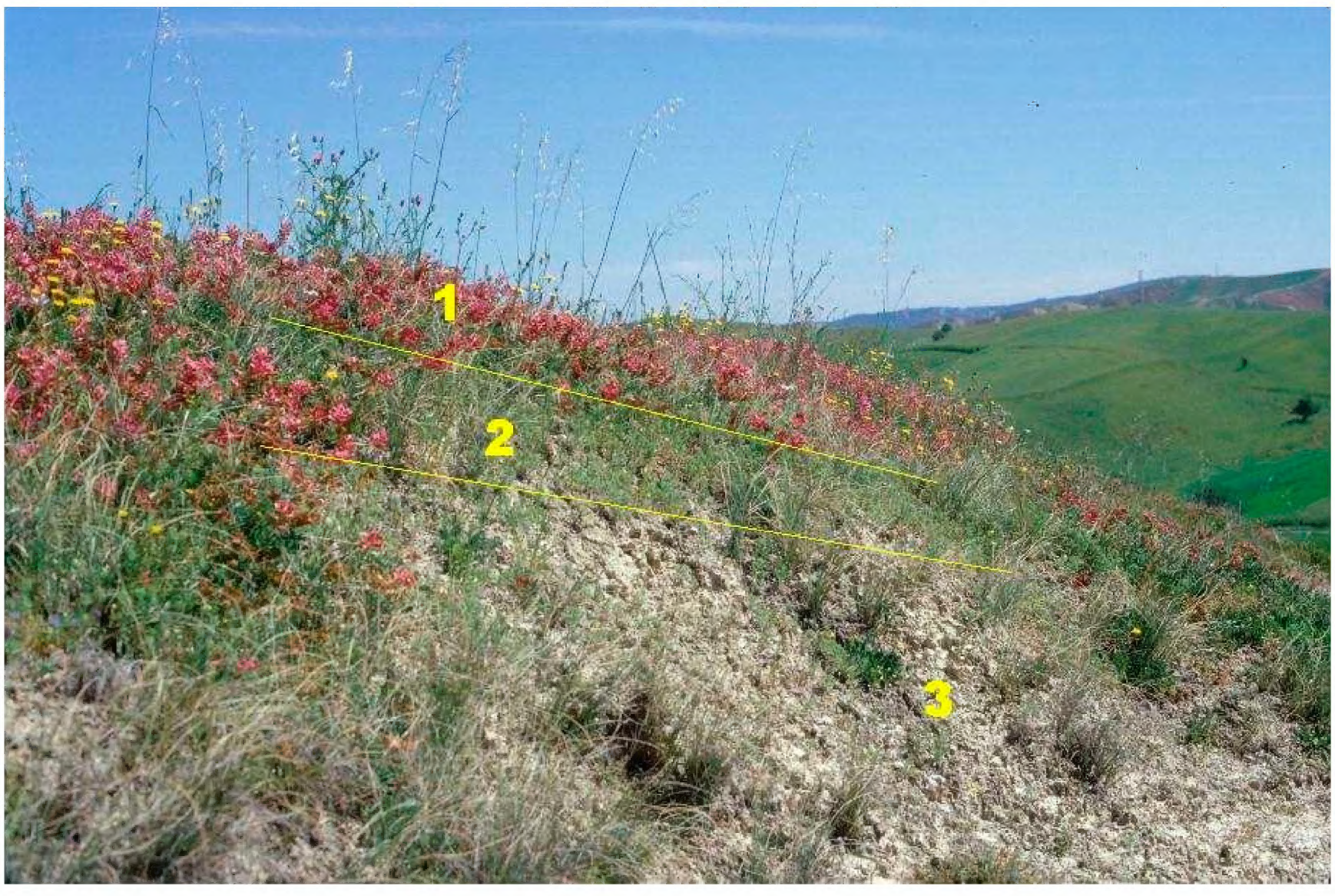

Figure 6. Micro-trasect of the upper part of a badland unit: 1) *Sulla coronaria* grasslands on the stable substrates of the badland top; 2) *Atractylis cancellata* micro edges; 3) L*ygeum spartum* open grasslands in the badland sector subjected to the highest degree of erosion.

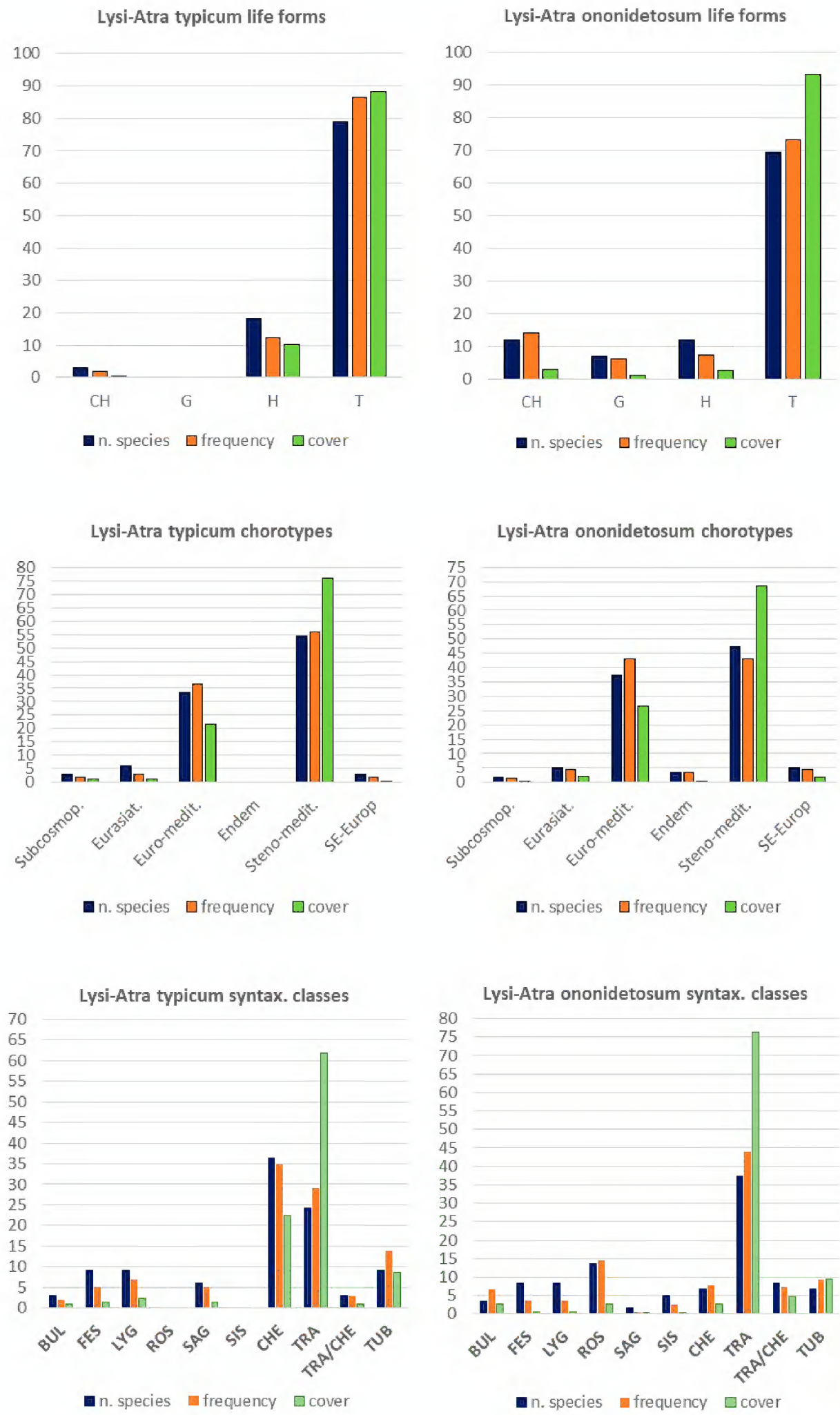

Figure 7. Life forms, chorological and syntaxonomic spectra of the *Lysimachio foeminae-Atractylidetum cancellatae* (Lys-Atra). The 3-digits codes in syntaxonomic spectra represent the class codes provided in the Eurovegchecklist (Mucina et al. 2016). Abbreviations: n. species = spectra based on presence/absence data; frequency = spectra weighted by species frequency; cover = spectra weighted by species cover-abundance.

of available annual species coming from the surrounding habitats (dry grasslands and micro-garrigues on limestone) and to the fact that the calcareous lithosols of the Murgia area are less oligotrophic than the sub-halophytic clays of the badlands.

Life forms and chorology - Therophytes dominates in all the life forms spectra followed by chamaephytes and hemycryptophytic with similar percentages. In the chorological spectrum steno-Mediterraneans taxa dominate followed by Euro-Mediterraneans. The other chorotypes exhibit percentages always lower than 5% (Fig. 7).

Syndynamic - The progressive vegetation succession consists of a first step dominated by the *Stipa austroitalica* steppe-like grasslands and a second one character-

Table 1. *Lysimachio foeminae-Atractylidetum cancellatae* ass. nova. Typ.= *Typus* of the association; sT= *typus* of subassociation *ononidetosum reclinatae*; n.a.=not available; 81 is the average percentage cover in the table.

		Relevè number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	**A-N**
		Altitude	360	355	350	345	225	220	230	325	280	300	260	275	295	290	280	280	**n.a**
		Aspect	ssw	ssw	ssw	ssw	se	sse	se	.									**n.a**
		Slope°	40	60	70	70	25	15	20	0	5	.	10	2	5	10	.	.	**n.a**
		Area m²	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	**1.5**
		Cover%	90	85	90	80	95	90	90	75	85	90	90	95	95	95	95	95	**81**
		Lysimachio foeminae-Atractylidetum typicum					Typ.							sT					
steno-Medit	T scap	*Atractylis cancellata*	**3**	**3**	**3**	**3**	**4**	**4**	**3**	**3**	5	4	4	4	5	5	5	4	**V**
euro-Medit	T rept	*Lysimachia foemina*	**1**	**+**	**2**	**+**	**1**	**2**	**+**	**1**	+	+	+	+	+	1	1		**.**
euro-Medit	T scap	*Helianthemum salicifolium*	**1**	**1**	**1**	**1**	**+**	**+**	**1**	**.**	+	.	1	+	2	+	2	2	**.**
steno-Medit	T scap	*Anacyclus clavatus*	**.**	**.**	**.**	**.**	**+**	**.**	**.**	**1**	.	.	.	.	.	.	.	.	**.**
steno-Medit	H caesp	*Lygeum spartum*	**+**	**1**	**1**	**+**	**+**	**.**	**.**	**.**	.	.	.	.	.	.	.	.	**.**
steno-Medit	T scap	*Parapholis incurva* subsp. *incurva*	**.**	**.**	**+**	**.**	**1**	**+**	**.**	**.**	.	.	.	.	.	.	.	.	**III**
		Lysimachio-Atractylidetum ononidetosum reclinatae																	
euro-Medit	T scap	*Ononis reclinata*	.	.	.	.	.	.	.	.	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**2**	**IV**
euro-Medit	T scap	*Bupleurum baldense*	.	.	.	.	.	.	.	.	**.**	**+**	**1**	**2**	**2**	**.**	**1**	**.**	**.**
euro-Medit	T scap	*Coronilla scorpioides*	.	.	.	.	.	.	.	.	**+**	**.**	**+**	**+**	**1**	**+**	**.**	**+**	**.**
		Onobrychido-Ptilostemion stellati																	
steno-Medit	T scap	*Filago eryocephala*	.	.	+	.	1	+	+	1	+	1	1	1	+	+	+	+	**.**
euro-Medit	T scap	*Catananche lutea*	.	.	.	.	+	1	.	.	.	.	.	.	.	.	.	.	**.**
steno-Medit	T scap	*Sulla capitata*	.	.	.	.	2	2	.	.	.	.	.	.	.	.	.	.	**.**
steno-Medit	T scap	*Onobrychis caput-galli*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	1	+	**V**
steno-Medit	T scap	*Hippocrepis ciliata*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	**.**
		Brachypodietalia distachyi* & *Stipo-Trachynietea distachyae																	
steno-Medit	T scap	*Brachypodium distachyon*	.	.	.	.	+	1	+	.	1	1	2	2	2	2	2	+	**V**
steno-Medit	T scap	*Hypochoeris achyrophorus*	1	1	.	.	.	.	.	.	1	1	2	.	1	2	2	1	**III**
euro-Medit	T scap	*Euphorbia exigua* subsp. *exigua*	.	.	.	.	+	.	.	.	1	.	+	1	1	+	.	+	**.**
euro-Medit	T scap	*Euphorbia falcata* subsp. *falcata*	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	1	**.**
euro-Medit	T rept	*Trifolium scabrum* subsp. *scabrum*	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	**V**
steno-Medit	T scap	*Linum strictum*	.	.	.	.	+	+	1	.	+	.	.	+	.	1	.	+	**V**
SE-Europ	T scap	*Crupina vulgaris*	.	.	.	.	.	.	.	.	+	.	1	.	1	1	+	1	**.**
steno-Medit	T scap	*Hippocrepis biflora*	+	1	.	1	+	1	+	.	.	.	.	.	.	.	.	.	**.**
euro-Medit	T scap	*Catapodium rigidum* subsp. *rigidum*	.	.	.	.	.	.	.	.	+	.	+	+	.	+	.	+	**I**
steno-Medit	T scap	*Hedypnois rhagadioloides*	.	1	.	.	+	+	.	.	.	.	+	.	.	.	.	.	**.**
euro-Medit	T scap	*Linaria simplex*	.	.	.	.	.	.	.	.	+	.	.	+	.	+	+	.	**.**
euro-Medit	T scap	*Scorpiurus muricatus*	.	.	.	+	1	2	.	.	.	.	.	.	.	.	.	.	**.**
euro-Medit	T scap	*Medicago minima*	.	.	.	.	.	.	.	.	.	+	.	+	.	.	+	.	**III**
steno-Medit	T scap	*Briza maxima*	.	.	.	.	.	.	.	.	.	+	1	.	1	.	.	.	**.**
eurasiat.	H caesp	*Poa infirma*	.	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	**.**
euro-Medit	T scap	*Silene gallica*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	**.**
steno-Medit	T rept	*Filago pygmaea*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	**III**
steno-Medit	T scap	*Stachys romana* subsp. *romana*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	**.**
euro-Medit	T scap	*Medicago monspeliaca*	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	**.**
steno-Medit	T scap	*Stipellula capensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	**III**
steno-Medit	T scap	*Tripodion tetraphyllum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	**V**
		Stipo-Trachynietea/Helianthemetea																	
steno-Medit	T scap	*Ononis ornithopodioides*	.	.	.	.	.	.	.	.	+	.	.	1	2	+	.	.	**.**
euro-Medit	T caesp	*Festuca myuros* subsp. *myuros*	.	.	.	.	.	.	.	.	.	.	+	2	.	+	.	2	**.**

Table 1. Continuation.

		Relevè number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	**A-N**
		Altitude	360	355	350	345	225	220	230	325	280	300	260	275	295	290	280	280	**n.a**
		Aspect	ssw	ssw	ssw	ssw	se	sse	se	.									**n.a**
		Slope°	40	60	70	70	25	15	20	0	5	.	10	2	5	10	.	.	**n.a**
		Area m²	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	**1.5**
		Cover%	90	85	90	80	95	90	90	75	85	90	90	95	95	95	95	95	**81**
		Stipo-Trachynietea/Chenopodietea																	
euro-Medit	T scap	*Anisantha madritensis* subsp. *madritensis*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.
steno-Medit	T scap	*Plantago lagopus*	.	.	.	.	.	.	.	.	.	2	.	.	.	.	1	2	.
steno-Medit	T scap	*Sonchus tenerrimus*	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.
SE-Europ	T scap	*Crepis sancta* subsp. *sancta*	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.
steno-Medit	T scap	*Rostraria hispida*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
		Species of clayey-slightly halophytic substrates																	
steno-Medit	H scap	*Sulla coronaria*	+	+	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.
steno-Medit	T scap	*Mantisalca duriaei*	.	.	.	.	+	+	.	+	.	.	.	.	.	.	.	.	.
SE-Europ	Ch frut	*Camphorosma monspeliaca*	+	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
		Rosmarinetea																	
steno-Medit	Ch suffr	*Phagnalon rupestre* subsp. *illyricum*	.	.	.	.	.	.	.	.	+	+	1	+	.	+	.	+	.
endemic	Ch suffr	*Helianthemum jonium*	.	.	.	.	.	.	.	.	+	.	+	+	+	.	+	+	.
steno-Medit	Ch suffr	*Fumana thymifolia*	.	.	.	.	.	.	.	.	+	+	.	+	+	1	.	+	.
steno-Medit	Ch suffr	*Fumana ericifolia*	.	.	.	.	.	.	.	.	+	.	+	+	+	.	+	.	.
steno-Medit	Ch frut	*Teucrium flavum* subsp. *flavum*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
steno-Medit	P caesp	*Cistus monspeliensis*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
euro-Medit	Ch suffr	*Helichrysum italicum* subsp. *italicum*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
		Lygeo-Stipetea																	
euro-Medit	T scap	*Avena barbata*	+	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.
steno-Medit	H scap	*Reichardia picroides*	.	.	+	+	.	.	.	.	.	.	.	.	.	+	.	.	**III**
euro-Medit	H scap	*Convolvulus cantabrica*	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.
steno-Medit	P caesp	*Andropogon distachyos*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
steno-Medit	G rhiz	*Asphodelus ramosus* subsp. *ramosus*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
SE-Europ	T scap	*Dasypyrum villosum*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
steno-Medit	H scap	*Carlina corymbosa*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
eurasiat.	H caesp	*Poa bulbosa*	.	.	.	.	.	.	.	.	1	1	1	1	+	+	.	1	**III**
		Chenopodietea* & *Sisymbrietea																	
steno-Medit	T scap	*Triticum neglectum*	+	+	.	.	1	1	.	+	.	1	1	+	+	.	.	+	**V**
euro-Medit	T scap	*Medicago polymorpha*	+	.	+	1	.	.	.	.	.	.	.	.	.	.	.	.	.
euro-Medit	T scap	*Brassica nigra*	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.
steno-Medit	T scap	*Erodium malacoides* subsp. *malacoides*	.	.	.	.	1	+	.	.	.	.	.	.	.	.	.	.	.
subcosmop	T scap	*Rostraria cristata*	.	+	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.
subcosmop	T scap	*Erodium cicutarium*	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.
euro-Medit	T scap	*Rapistrum rugosum*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.
steno-Medit	T scap	*Lolium rigidum*	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
euro-Medit	T scap	*Reseda phyteuma* subsp. *phyteuma*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
		Festuco-Brometea																	
steno-Medit	G bulb	*Romulea bulbocodium*	.	.	.	.	.	.	.	.	+	.	.	+	+	+	1	+	.
euro-Medit	G bulb	*Allium vineale*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.
euro-Medit	T scap	*Trifolium leucanthum*	.	+	.	.	+	.	+	.	.	.	.	.	.	.	.	.	.
eurasiat.	H scap	*Poterium sanguisorba* subsp. *balearicum*	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.
endemic	H caesp	*Stipa austroitalica* subsp. *austroitalica*	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
steno-Medit	G bulb	*Ornitoghalum gussonei*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.

Table 1. Continuation.

		Relevè number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	**A-N**
		Altitude	360	355	350	345	225	220	230	325	280	300	260	275	295	290	280	280	**n.a**
		Aspect	ssw	ssw	ssw	ssw	se	sse	se	.									**n.a**
		Slope°	40	60	70	70	25	15	20	0	5	.	10	2	5	10	.	.	**n.a**
		Area m²	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	**1.5**
		Cover%	90	85	90	80	95	90	90	75	85	90	90	95	95	95	95	95	**81**
eurasiat.	T par	*Cuscuta epithymum* subsp. *epithymum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	**.**
steno-Medit	H scap	*Salvia verbenaca*	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	**.**
eurasiat.	H ros	*Plantago lanceolata*	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	**.**
		Diff. *Atractylido-Neatostometum apuli*																	
steno-Medit	T scap	*Neatostema apulum*																	**V**
steno-Medit	G bulb	*Moraea sisyrinchium*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**V**
steno-Medit	T scap	*Sulla spinosissima*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**V**
steno-Medit	T scap	*Anisantha fasciculata* subsp. *fasciculata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**V**
steno-Medit	T scap	*Catapodium pauciflorum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**
euro-Medit	T scap	*Lagurus ovatus* subsp. *nanus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**
steno-Medit	G bulb	*Scorzonera undulata* subsp. *deliciosa*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**III**
steno-Medit	T scap	*Polygala monspeliaca*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**I**
euro-Medit	T scap	*Trifolium stellatum*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**
steno-Medit	H scap	*Kundmannia sicula*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**V**
steno-Medit	T scap	*Anthemis arvensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**
euro-Medit	T scap	*Trifolium cherleri*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**
endemic	H scap	*Scorzonera villosa* subsp. *columnae*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**IV**
euro-Medit	T scap	*Carthamus lanatus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**III**
euro-Medit	G bulb	*Prospero autumnale*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**II**
steno-Medit	T scap	*Lotus edulis*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**II**
eurasiat.	T scap	*Sonchus oleraceus*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**II**
steno-Medit	H ros	*Plantago serraria*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	**II**

ized by Mediterranean maquis scrubs (*Helictotricho-Pistacietum lentisci, Juniperetum phoeniceae-macrocarpae* Di Pietro et Misano 2010, *Cyclamino repandi-Paliuretum spinae-christi* Biondi et al. 1999).

Syntaxonomy - The *Lisymachio foemine-Atractylidetum cancellatae* is an association provisionally described (sub *Anagallido foeminae-Atractylidetum cancellatae*) for the vegetation mosaic of the Lucanian badlands (Fascetti et al. 2001; Di Pietro et al. 2003) whose validation has never been formalized. The new samples from the Murgia territories of Apulian and Basilicata regions allowed to enlarge the distribution area and the ecological spectrum of this association that we consider as divided into two subassociations: *typicum* and *ononidetosum reclinatae*. In this paper we validate the *Lisymachio foemine-Atractylidetum cancellatae* taking into account the chronology of the studies that have concerned this community over time. Accordingly, we have here established as subassociation "*typicum*" the one comprising the relevés performed on the salty-clayey substrates of the Lucanian badlands, which is the place where the association was originally (invalidly) described. Instead, the subassociation *Lisymachio foemine-Atractylidetum cancellatae ononidetosum reclinatae* is restricted to the limestone substrates of the Murgia plateau of the Matera administrative territory.

The *Lisymachio foemine-Atractylidetum cancellatae* is strictly limited to southern Italy where *A. cancellata* range extends. At present, we have no knowledge about other associations in which *A. cancellata* acts as dominant species. The only reference for the Italian peninsula is the association *Atractylido-Neatostometum apuli* described for western Sicily (Brullo et al. 1994) which exhibit some similarities due to a shared *Brachypodietalia distachyi* floristic background. However, *Atractylido-Neatostometum apuli* exhibits a higher sub-halophytic and xerophilous character, probably related to the rocky coastal habitats in which this association was described, and a floristic composition quite different from that of *Lysimachio-Atractylidetum cancellatae* (see A-N synoptic column in Table 1). In addition to the lack of *Neatostoma apulum*, there are other high-frequency and characteristic species of *Atractylido-Neatosometum apuli* that are missing in *Lysimachio foeminae-Atractylidetum cancellatae* (e.g., *Anthemis arvensis, Anisantha fasciculata, Catapodium marinum, Kundmannia sicula, Moraea sisyrinchium, Sulla spinosissima*) which do not allow to classify our relevés under this community.

The classification of *Lysimachio foeminae-Atractylidetum cancellatae* at syntaxonomic ranks higher than association is rather complex. The ephemeral communities that develop on limestone substrates or more generally on the neutral-alkaline ones that do not have an extremely limiting factor in the mineral component of the soil tend to be dominated by a group of wide-distribution steno-Mediterranean species occurring throughout the whole Mediterranean coastal and subcoastal areas. These communities are often distinguished each-other by differences in the abundance-dominance values of the species more than by the occurrence of unshared diagnostic characteristic species. As regards the classification of the *Lysimachio-Atractylydetum cancellatae* in the higher-rank syntaxa, two different options are available: i) to adopt a conservative choice considering few large-scale syntaxa well-distinguishable from a floristic and chorological point of view, ii) to opt for a more divisive choice considering a syntaxonomic framework based on a higher number of alliances having a more or less similar floristic composition. De Foucault (1999) followed this second option distributing the European therophytic dry grasslands into many alliances and orders. In our specific case, we included *Lysimachio-Atractylidetum* into the *Stipo-Trachynietea distachyae* class, whose verbal diagnosis ("Mediterranean calciphilous annual and ephemeroid swards and grasslands", Mucina et al. 2016) is well suited for the community in issue. As regards the rank of order, Rivas-Martínez (1978) classified *Atractylis cancellata* among the characteristic species of the order *Trachynietalia distachyae*. In contrast, Brullo et al. (2001) classified *A. cancellata* as characteristic species of the order *Stipo-Bupleuretalia semicompositi* which they considered as xerothermic variant of the *Trachynietalia distachyae*. Biondi et al. (2014) confirmed the syntaxonomic framework of Brullo et al. (2001) except for the rank of class where the *Stipo-Trachynietea* (sub: *Stipo-Brachypodietea distachyae* (Br.-Bl. in Br.-Bl., Emberger & Molinier 1947) Brullo 1985) was considered a later synonym of *Helianthemetea guttati* (sub: *Tuberarietea guttatae* (Br.-Bl. in Br.-Bl., Roussine & Négre 1952) Rivas Goday & Rivas-Mart. 1963). On the other hand, Mucina et al. (2016), who considered the *Trachynietalia distachyae* (synonym of *Brachypodietalia distachyi*) as a strictly W-Mediterranean order, advanced the hypothesis of classifying the *Stipo-Bupleuretalia semicompositi* in the *Saginetea maritimae* this order being typified by the *Plantagini-Catapodion marini*, an alliance comprising the sub-halophilous therophitic communities of the coastal areas. Accordingly, Mucina et al. (2016) proposed the new order *Ptilostemono stellati-Vulpietalia ciliatae* for "the Central and Eastern Mediterranean therophytic swards on shallow sandy and loamy soils over limestone and gypsum substrates". In this new provisional order the authors included the following alliances: *Onobrychido-Ptilostemonion stellati*, *Vulpio ciliatae-Crepidion neglectae*, *Xeranthemion annui*, *Vulpion ligusticae*. It is interesting to note that, basing on different reasons, the Prodrome of Italian Vegetation (Biondi et al. 2014) and the Eurovegchecklist (Mucina et al. 2016) considered the xerothermic therophytic communities of the central Mediterranean as belonging to an order other than *Trachynietalia distachyae* (*Brachypodietalia distachyi*). Mucina et al. (2016) based their hypothesis on biogeographical reasons (*Brachypodietalia distachyi* was classified as a strictly W-Mediterranean order) whereas Biondi et al. (2014) based their hypothesis on bioclimatic reasons (*Trachynietalia distachyae* would not be occurring in dry Thermo and Infra-Mediterranean bioclimates where it would be substituted by *Stipo-Bupleuretalia semicompositi*). In our opinion, the main problem is that *Stipo-Bupleuretalia* and *Brachypodietalia distachyi* exhibit a clear floristic-ecological-biogeographical overlapping. It is not by chance that De Foucault (1999) considered the alliance *Trachynion distachyae* (proposed under the new name *Sideritido-Brachypodion distachyi*) as partly belonging to the *Stipo-Bupleuretalia semicompositi* and partly to the *Trachynietalia distachyae*. The syn-chorological question is therefore to establish whether *Brachypodietalia distachyi* (= *Trachynietalia distachyae* syntax. syn.) could be a proper reference for the therophytic communities of southern Italy, considering that it was already and abundantly used for similar communities in central Italy (Filesi et al. 1996; Biondi et al. 1997; Di Pietro et al. 2002; Fanelli et al. 2010). Instead, the ecological question is to establish whether *Brachypodietalia distachyi* is sufficiently "xerophilous" to include the highly xerothermic communities of southern Italy. To answer these questions, we can do nothing but base ourselves on the original diagnosis of the syntaxa in question and on their groups of characteristic species. The order *Trachynietalia distachyae* was originally defined as including all the therophytic communities occurring throughout the Mediterranean basin on neutral-basic substrates (Rivas-Martínez 1978). Among the characteristic species of this order are included the majority of the annual species we found in the *Lysimachio-Atractylidetum cancellatae*, such as *Atractylis cancellata*, *Brachypodium distachyon*, *Catapodium rigidum*, *Crupina crupinastrum*, *Euphorbia exigua*, *Linum strictum*, *Stachys romana* (etc.). The original diagnosis of the alliance *Trachynion distachyae* (sensu Rivas-Martínez 1978) perfectly overlapped the diagnosis of the order, as regards the chorological aspects, where instead it differed from it in ecological terms. In fact, the ecological range of *Thero-Brachypodion* was originally defined as including only the therophytic communities distributed within the potential vegetation areas for the *Quercetalia ilicis* and the thermophilous fringe of *Quercetalia pubescenti-petraeae*. Instead, the therophytic communities developed within the potential vegetation areas for the *Pistacio-Rhamnetalia alaterni* were referred to the *Stipion retortae*. Among the characteristic species of the *Thero-Brachypodion* there are taxa (*Bupleurum baldense*, *Campanula erinus*, *Ononis reclinata*) which occur in our samples, together with taxa (*Euphorbia sulcata*, *Dianthus nudiflorus*, *Hornungia petraea* and *Neatostema apulum*) which occur in Italy but not in our samples, and other taxa (the majority) which

exhibited a W-Mediterranean distribution non including Italy (e.g., *Arabis parvula*, *Astragalus stella*, *Brachyapium dichotum*, etc.). On the other hand, *Stipo-Bupleuretalia semicompositi* is typified by a sub-halophilous coastal alliance (*Sedo-Ctenopsion gypsophilae*), but includes also many "non halophilous" associations belonging to the thermo-Mediterranean bioclimate. In the Aspromonte massif (Brullo et al. 2001), *Atractylis cancellata* was reported as a high-frequency species in the communities of the alliance *Onobrychido-Ptilostemonion stellati*. This alliance, which included the neutral and basiphilous therophytic communities of the Infra- and Thermo-Mediterranean bioclimates was proposed as a geographical vicariant of the *Stipion retortae* in the central Mediterranean. However only *Ptilostemon stellatus*, out of the seven characteristic species designated in the diagnosis (Brullo et al. 2001), exhibits a distribution restricted to C-Mediterranean (southern Italy and W-Balkans) whereas the others (*Onobrychis caput-galli*, *Crucianella angustifolia*, *Hippocrepis ciliata*, *Filago eriocephala*, etc.) exhibited a wide Mediterranean distribution.

The associations belonging to the *Onobrychido-Ptilostemonion stellati* exhibit a clear prevalence of xerophytic therophytes (e.g., *Stipellula capensis*, *Trifolium scabrum*, *Evax pygmaea*, *Ononis reclinata*, *Plantago lagopus*) which are also common in the most of the *Brachypodietalia distachyi* communities. It is therefore confirmed that *Brachypodietalia distachyi* and *Stipo-Bupleruetalia semicompositi* are widely overlapping and the presumed vicariant distribution areas of these two syntaxa (i.e., *Brachypodietalia distachyi* in the western Mediterranean and *Stipo-Bupleuretalia semicompositi* in the central-eastern Mediterranean) are not consistent in floristic terms. *Atractylis cancellata* being originally considered a characteristic species of the *Brachypodietalia distachyi* and the latter order having nomenclatural priority over *Stipo-Bupleuretalia semicompositi* we have opted to use *Brachypodietalia distachyi* as a reference for *Lysimachio-Atractylidetum cancellatae* and to consider *Stipo-Bupleuretalia semicompositi* as a pro-parte syntaxonomic synonym. As regards the choice of the alliance we have decided to assign a surplus of diagnostic value (both in ecological and biogeographic terms) to the guide-species of the association. This procedure is not a novelty in terms of syntaxonomic classification. For example, the order *Pinetalia halepensis* is essentially based on the dominance of *Pinus halepensis* in communities almost completely composed of *Pistacio-Rhamnetalia* and *Quercetalia ilicis* characteristic species (see Pesaresi et al. 2017). As regards grasslands the most emblematic case is probably the decisive role played by the circumboreal *Carex myosuroides* (= *Kobresia myosuroides*) in the decision of using the class *Carici-Kobresietea* instead of *Elyno-Seslerietea* for the classification of the rush-sward grasslands of the central Apennines although the latter were almost completely composed of SE-European orophytes (Biondi et al. 2000; Blasi et al. 2003; Chytry et al. 2015). For this reason, the large dominance of *Atractylis cancellata* in the *Lysimachio-Atractylidetum* does not allow, in our opinion, to classify this association neither in the *Trachynion distachyae* nor in other alliances considered by Mucina et al. (2016) as possibly occurring in Italy, such as *Vulpio ciliatae-Crepidion neglectae* and *Vulpion ligusticae*. In fact, *A. cancellata* is a South-Mediterranean/Irano-Turanian species typical of habitats which are too dry and warm to be related to the original diagnosis of the *Trachynion distachyae* (Izco 1974; Rivas-Martinez 1976; Lapraz 1982; Izco et al. 1986). It is not by chance that Guinochet (1978) proposed the alliance *Atractylido cancellatae-Stipion retortae* Guinochet 1978 for the dry sub-steppic territories of north-Africa. For this reason, we classified the *Lysimachio-Atractylidetum* in the *Onobrychido-Ptilostemonion stellati* and proposed the displacement of this alliance from *Stipo-Bupleretalia semicompositi* to the *Brachypodietalia distachyi*. The *Onobrychido-Ptilostemonion stellati* was originally described as an alliance not specifically linked to a particular type of substrate. For this reason, it appears as well suited to host the *Lysimachio-Atractylidetum cancellatae*, this association being found on different bedrock types, such as Pliocene clays, Quaternary sands, and limestones. In chorological terms the *Onobrychido-Ptilostemonion stellati* acts as a central Mediterranean vicariant of the W-Mediterranean *Stipion retortae* and the north-eastern-African *Atractylido-Stipion retortae* Guinochet 1978. However, adopting a less divisive syntaxonomic interpretation, these three alliances could be brought together within a single central and western Mediterranean alliance whose nomenclatural priority would go to the *Stipion retortae*. In fact, precisely to the *Stipion retortae* made reference Guarino and Pasta (2017) in their classification of the therophytic ephemeral swards of the alkaline loamy and clayey substrates of western Sicily.

CAMPANULO ERINI-MICROMERIETUM MICROPHYLLI ass nov. (Table 2)

Name - Campanulo erini-Micromerietum microphylli Di Pietro, Misano, Fortini et Terzi ass nov. (*Holotypus* rel. 6, Table 2).

Characteristic taxa - Micromeria microphylla, *Campanula erinus*, *Festuca danthonii* subsp. *danthonii*, *Festuca myuros* subsp. *myuros*, *Silene conica*.

Dominant taxa - Micromeria microphylla, *Medicago minima*, *Stipellula capensis*, *Trifolium scabrum*, *Poa bulbosa*, *Helianthemum salicifolium*, *Ononis reclinata*.

High frequency taxa - Micromeria microphylla, *Campanula erinus*, *Ononis reclinata*, *Silene conica*, *Medicago minima*, *Erodium cicutarium*, *Trifolium scabrum*, *Stipellula capensis*.

Synecology - Small-size communities (1 m² or less) developed on the extremely superficial substrates of the limestone outcrops of the Murgia hills where they are found on flattish sites characterized by extremely shallow soils (1-2 cm deep) (Fig. 8). The community exhibits the co-dominance of *Micromeria microphylla* and various annual species. *Micromeria microphylla* in addition of being the syntaxon name-giving species is the only high-frequency chamaephyte occurring in the community (the

other one, *Ajuga iva*, occurs in two relevés only). Where soils are slightly deeper, the *Campanulo-Micromerietum microphyllae* tends to be colonized by taller annual grasses, such in particular *Stipellula capensis* (sub-nitrophilous variant with *Stipellula capensis*, Table 2). The preferential location of the community in environments not completely free from anthropic disturbance (especially human and animal trampling) justifies the occurrence of some sub-nitrophilous annual species, such as *Erodium cicutarium*, *Plantago lagopus*, *Rostraria cristata*, *Sonchus tenerrimus*.

Life forms and chorology - Therophytes dominate in all the life forms spectra. These are followed by the chamaephytes, whose high values in the cover spectrum are almost exclusively due to the contribution of *Micromeria microphylla*. In the chorological spectrum Euro-Mediterranean species dominates followed by the steno-Mediterranean ones. Surprisingly high are the percentages of the Eurasiatic component (Fig. 9).

Syndynamic - The evolution of the soils leads the *Campanulo erini-Micromerietum microphylli* to be substituted by therophytic communities of greater size, as those dominated by *Stipellula capensis*, and subsequently by Mediterranean garrigues with *Corydothymus capitatus* and *Helianthemum jonium*. The final stage of the dynamic succession is a Mediterranean maquis community dominated by *Pistacia lentiscus* and *Phillyrea latifolia*.

Syntaxonomy - Despite the apparent floristic simplicity, the *Campanulo erini-Micromerietum microphylli* is nevertheless problematic as regards its classification at the highest ranks of syntaxonomy. The physiognomic dominance of *Micromeria microphylla*, although not overwhelming, would suggest a possible classification in the *Cisto incani-Ericion multiflorae*, in particular in the micro-garrigue sub-alliance *Thymo capitati-Helianthemenion jonii* Di Pietro and Misano 2010 which was described precisely in the western Murgia Plateau (Di Pietro and Misano 2010). On the other hand, the preferential location on natural calcareous pavement, and the occurrence in the community of *Petrorhagia saxifraga*, accompanied by therophytes such as *Arenaria leptoclados*, *Campanula erinus*, *Herniaria glabra*, *Silene conica*, *Sabulina tenuifolia* and *Valerianella muricata* suggest to classify the *Campanulo erini-Micromerietum microphylli* in the *Sedo-Scleranthetea*. A third hypothesis, would be that of classifying this community in the *Trachynietea distachyae* taking into account the absolute dominance of the steno-Mediterranean therophytic component (both as number of species and cover percentage). A fourth and last option (unlikely in truth) would be to consider this community in the less synanthropic fringe of *Chenopodietea*, considering the partial anthropogenic character of the environments in which this community was found. The phytosociological literature is rather scarce as regards communities similar to the *Campanulo-Micromerietum*. In Sicily *Micromeria microphylla* is reported as a guide species of the association *Putorio calabricae-Micromerietum microphyllae* nom. inval. (Brullo and Marcenò 1979; Brullo et al.

Figure 8. 1) *Campanulo erini-Micromerietum microphyllae* on the calcareous pavements 2) *Stipellula capensis* stands on deeper soils.

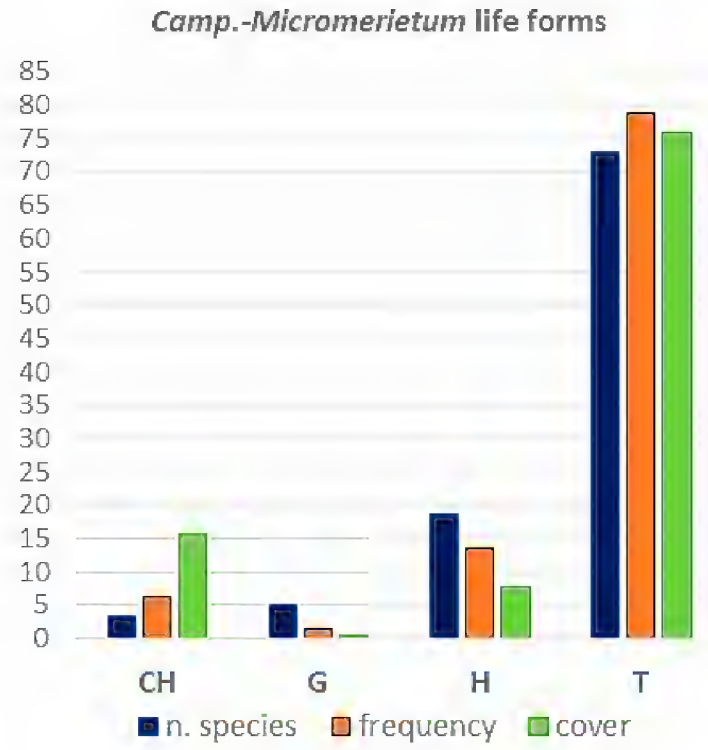

Figure 9. Life forms, chorological and syntaxonomic spectra of the *Campanulo erini-Micromerietum microphyllae* (Camp.-Micromerietum). The 3-digits codes in syntaxonomic spectra represent the class codes provided in the Eurovegchecklist (Mucina et al. 2016). Abbreviations: n. species = spectra based on presence/absence data; frequency = spectra weighted by species frequency; cover = spectra weighted by species cover-abundance.

2004) which was subsequently validated with the name *Micromerio microphyllae-Putorietum calabricae* Brullo et Marcenò ex Terzi, Jasprica et Caković 2017 (Terzi et al. 2017). This is a chasmophytic association composed of two subassociations (*typicum* and *chiliadenetosum boccoonei*) which was classified in the *Dianthion rupicolae*, an alliance endemic to southern Italy in the class *Asplenietea trichomanis* (Terzi et al. 2017, 2018). The chasmophytic behavior of *Micromeria microphylla* was also reported by Lucchese and Pignatti (2013) who recorded the sporadic occurrence of this species within the ancient Roman walls of Ostia Antica (Rome, Italy) and hypothesized its arrival to be related with the transport of marble blocks from distant locations. The authors named the community with dominant *Micromeria microphylla* occurring on the walls of Ostia Antica simply as "*Micromeria microphylla* community" and classified it in the *Parietarietea judaicae*. However, none connection with *Asplenietea trichomanis* or *Parietarietea judaicae*, either ecological or floristic, was identifiable for the *Campanulo erini-Micromerietum microphylli* of the Murgia hills. A classification in the *Ononido-Rosmarinetea* does not seem feasible too. Although the *Ononido-Rosmarinetea* communities are abundant in the study area, especially on rocky or pebbly substrates, these are normally characterized by a clear physiognomic dominance of nano-phanerophytes and chamaephyes (Di Pietro and Misano 2010). Looking exclusively at the lithological and geomorphological characteristics of the sampled sites (fissured and flat limestone pavements), the reference to the *Sedo-Scleranthetea* would seem the most appropriate. However, observing the specific composition of the community, the most typical species of *Sedo-Scleranthetea* were absent, in particular those belonging to the genus *Sedum* and therophytes, such as *Alyssum alyssoides*, *Erophyla verna*, *Hornungia petraea*, *Saxifraga trydactylites*, *Thlaspi perfoliatum* (etc.). The dominance of steno-Mediterranean therophytes suggested us to classify the *Campanulo erini-Micromerietum microphylli* in the *Stipo-Trachynietea distachyae* (*Brachypodietalia distachyae*, *Trachynion distachyae*). In fact, although, *Micromeria microphylla* is the species displaying the highest specific cover index considering the entire phytosociological table, its cover values in several samples are comparable to those of some therophytes, such as *Campanula erinus*, *Medicago minima* or *Stipellula capensis*. Moreover, the extremely small size of *Micromeria microphylla* make this species physiognomically and functionally comparable to a small therophyte. However, the doubt in the choice between *Trachynietea distachyae* and *Sedo-Scleranthetea* is legitimate and recurrent. In particular, coenological overlaps and classification difficulties between *Sedo-Scleranthetea* and *Trachynietea distachyae* are well-known especially as regards those communities in which the dominant guide-species are therophytes (i.e., *Chaenorhino-Saxifragetum trydactylites*, *Acino-Trifolietum scabri* etc.). In our case, the situation is even more complex and would seems to be unbalanced towards the *Sedo-Scleranthetea* since the community has a micro-chamaephyte as guide-species.

Table 2. *Campanulo erini-Micromerietum microphyllae* ass. nov. Typ.= *Typus* of the association.

		Relevè number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
		Altitude	115	115	115	115	115	115	115	115	115	115	115	115	115	115
		Aspect	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Slope°	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Area m²	1	1	1	1	1	1	1	1	1	1	1	1	1	1
		Cover%	40	30	50	35	50	35	40	35	60	40	40	50	60	80
		Campanulo erini-Micromerietum microphylli						Typ.								
steno-Medit	Ch Suffr	*Micromeria microphylla*	1	2	3	3	3	3	2	2	2	2	3	3	2	2
steno-Medit	T scap	*Campanula erinus*	1	2	+	2	2	+	+	1	+	2	2	1	+	+
Eurasiat	T scap	*Silene conica*	+	.	+	+	+	+	+	+	+	1	+	.	1	1
Euro-Medit	T caesp	*Festuca danthonii* subsp. *danthonii*	.	+	2	2	2	2	.	.	2	.	.	1	+	2
Euro-Medit	T caesp	*Festuca myuros* subsp. *myuros*	+	.	.	+	.	+	1	+	.	+	+	.	2	1
		subnitrophylous variant with *Stipellula capensis*														
steno-Medit	T scap	*Stipellula capensis*	+	.	1	1	.	.	+	2	3	3	2	2	2	2
		Trachynion distachyae, Brachypodietalia distachyi; Stipo-Trachynietea distachyae														
Euro-Medit	T scap	*Ononis reclinata*	1	2	2	3	2	+	+	2	2	2	3	2	2	1
Euro-Medit	T scap	*Medicago minima*	2	.	2	.	3	3	+	2	3	3	2	1	3	3
Euro-Medit	T rept	*Trifolium scabrum*	2	+	+	3	.	.	+	1	2	.	1	1	3	2
Euro-Medit	T scap	*Lagurus ovatus*	.	+	+	+	+	.	.	.	+	+	.	+	+	+
Euro-Medit	T scap	*Helianthemum salicifolium*	.	.	.	.	2	1	1	.	3	1	2	.	.	.
steno-Medit	T scap	*Hypochaeris achyrophorus*	+	+	+	+	+	.	.	+	.	.	.	+	.	.
steno-Medit	T scap	*Trisetaria aurea*	+	.	.	.	.	2	.	.	.	+	.	2	+	+
Euro-Medit	T scap	*Crepis neglecta* subsp. *corymbosa*	+	.	.	.	+	+	+	.	.	+	.	.	+	.
Eurasiat	T scap	*Trifolium campestre*	.	.	+	3	.	+	+	.	.	.	.	.	.	.
Euro-Medit	T scap	*Trifolium stellatum*	.	.	.	+	.	.	.	+	.	.	.	+	+	1
Euro-Medit	T scap	*Catapodium rigidum*	.	+	.	.	.	+	.	.	+	.	.	.	.	.
Euro-Medit	T scap	*Hippocrepis biflora*	+	.	2	.	.	.	.	.	+	.	.	.	.	.
Euro-Medit	T scap	*Filago pyramidata*	.	.	.	.	.	.	+	.	.	+	.	+	.	.
steno-Medit	T scap	*Stachys romana*	.	.	.	.	.	.	.	.	.	.	+	.	.	+
		Chenopodietea* & *Sisymbretea														
Euro-Medit	H ros	*Erodium cicutarium*	1	1	.	.	1	+	+	2	+	1	+	2	+	.
endemic	H scap	*Crepis bursifolia*	.	.	.	+	+	+	.	.	.	+	+	.	+	1
steno-Medit	T scap	*Rostraria cristata*	.	.	+	.	+	+	+	.	.	+	.	.	.	.
steno-Medit	T scap	*Silene nocturna*	.	.	+	.	+	.	.	.	+	.	.	+	.	.
Euro-Medit	T scap	*Trifolium nigrescens*	.	.	.	.	.	2	+	.	+	+	.	+	.	.
steno-Medit	T scap	*Trisetaria panicea*	.	.	.	.	.	+	.	.	.	.	.	.	.	.
steno-Medit	H scap	*Asphodelus fistulosus*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
steno-Medit	T scap	*Glebionis segetum*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
steno-Medit	T scap	*Sonchus tenerrimus*	.	.	.	.	.	.	.	.	.	.	.	.	.	+
steno-Medit	T scap	*Bromus scoparius*	.	.	.	.	.	.	.	.	.	+	.	+	.	.
Euro-Medit	T scap	*Calendula arvensis*	.	.	.	.	.	.	.	.	.	.	.	.	.	+
steno-Medit	T scap	*Hedypnois rhagadioloides*	.	.	.	.	.	.	.	.	.	+	.	.	.	.
		Chenopodietea/Trachynietea														
steno-Medit	T scap	*Medicago truncatula*	2	+	.	.	+	+	.	+	.	+	.	.	.	.
Euro-Medit	T scap	*Parentucellia latifolia*	+	.	.	.	1	.	.	+	+	.	.	.	1	+
steno-Medit	T scap	*Trigonella esculenta*	+	.	.	.	.	.	.	1	.	.	.	.	+	+
steno-Medit	T scap	*Plantago lagopus*	.	.	.	.	.	.	.	.	+	.	.	+	.	.
Euro-Medit	T scap	*Cerastium glomeratum*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
		Festuco-Brometea														
Euro-Medit	G bulb	*Muscari comosum*	.	.	.	.	+	.	.	.	.	+	.	.	.	.
Eurasiat	T par	*Cuscuta epithymum*	.	.	.	.	.	.	.	.	.	.	.	.	+	+
SE-Europ	G rhiz	*Scorzonera villosa* subsp. *columnae*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Eurasiat	H bien	*Centaurium erythraea*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Euro-Medit	H scap	*Eryngium campestre*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Euro-Medit	H scap	*Stachys germanica* subsp. *salviifolia*	.	.	.	.	.	.	.	+	.	.	.	.	.	.
		Sedo-Scleranthetea														
Eurasiat	T scap	*Arenaria leptoclados* subsp. *leptoclados*	.	2	+	2	.	+	+	.	+	.	.	2	.	+
steno-Medit	Ch Suffr	*Ajuga iva*	.	.	.	+	+	.	.	.	.	+	.	.	.	.
Euro-Medit	T scap	*Ajuga chamaepitys*	+	+	.	.	.	.	.	+	+	.	.	.	.	.
Euro-Medit	H caesp	*Petrorhagia saxifraga* subsp. *gasparrinii*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Euro-Medit	T scap	*Petrorhagia prolifera*	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Eurasiat	T scap	*Sabulina tenuifolia* subsp. *tenuifolia*	.	.	.	.	.	+	.	.	.	.	.	.	.	.
steno-Medit	T scap	*Valerianella muricata*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Eurasiat	T scap	*Herniaria glabra* subsp. *glabra*	.	.	.	.	+	.	.	.	.	.	.	.	.	.
		Artemisietea														
steno-Medit	H scap	*Salvia verbenaca* (incl. *S. clandestina*)	.	.	+	.	+	.	.	.	.	.	.	.	.	.
steno-Medit	H bien	*Sixalix atropurpurea*	.	.	.	.	+	.	.	.	.	.	.	.	.	.
steno-Medit	H scap	*Hypericum triquetrifolium*	.	.	+	.	.	.	.	.	.	.	.	.	.	.
		Lygeo-Stipetea* & *Poetea bulbosae														
Eurasiat	H caesp	*Poa bulbosa*	3	1	+	.	.	.	+	1	+	.	+	.	1	1
Euro-Medit	T scap	*Avena barbata*	.	.	.	.	+	.	+	.	.	.	.	+	.	.
subcosmop	G rhiz	*Cynodon dactylon*	.	.	.	.	.	.	.	.	.	.	.	.	.	1
steno-Medit	T scap	*Astragalus sesameus*	.	.	.	.	.	.	.	.	.	.	.	.	.	+
steno-Medit	T scap	*Trifolium suffocatum*	.	.	.	.	.	+	.	.	.	.	.	.	.	.

However, the aforementioned reasons seem consistent with our choice to opt for the *Stipo-Trachynietea*. Fanelli (2007), in order to discriminate between the two classes emphasized on the important diagnostic role played by the bryophytic component in the *Sedo-Scleranthetea* communities, whereas it would be significantly lower in the *Stipo-Trachynietea* ones. In the case of *Campanulo-Micromerietum microphylli* the role of the bryophytic component was found to be very low (substancially limited to a low cover percentage of *Grimmia pulvinata*) and this would further support our choice to classify the community in the *Stipo-Trachynietea*.

STIPO AUSTROITALICAE-HYPARRHENIETUM HIRTAE Biondi et Guerra 2008 (Table 3)

The communities dominated by *Hyparrhenia hirta* characterize the lower parts of the Murgia of Gravina and replace the grasslands dominated by *Stipa austroitalica* and *Scorzonera villosa* subsp. *columnae* of the summit areas of the Murgia plateau. These communities exhibits intermediate floristic features between three classes (*Festuco-Brometea*, *Lygeo-Stipetea* and *Festuco hystricis-Ononidetea striatae*) and testify the coenological transition between the Apennine-Balkan biogeographical province (Euro-Siberian Region) and the Adriatic province (Mediterranean Region). This transition is clearly observable moving from the summit areas of the Murgia plateau, still affected by cold winds from north-eastern Europe, to the lowlands facing the Taranto Gulf where the influence of the warm winds of south-western origin occurs. *Hyparrhenia hirta* is absolutely the dominant species of these xerothermic steppe-like communities especially when developed on partially leached soils rich in fine debris. *Stipa austroitalica* is constantly occurring in the dominant tall grasses layer, whereas *Scorzonera villosa* subsp. *columnae* do the same in the undergrowth. In addition, the *Hyparrhenia hirta* communities host some species typical of the *Hippocrepido-Stipion austroitalicae* dry-grasslands (*Festuco-Brometea*) such as *Hippocrepis glauca*, *Anthyllis vulneraria* subsp. *rubriflora*, *Convolvulus elegantissimus*. The steno-Mediterranean and Euro-Mediterranean component however remains dominant and would justify the classification of this community in the *Lygeo-Stipetea*, *Hyparrhenietalia hirtae* and *Hyparrhenion hirtae* as already proposed in Biondi and Guerra (2008). As regards the rank of order we object to a purely nomenclatural question, namely we have followed Mucina et al. (2016) which consider *Cymbopogono-Brachypodietalia ramosi* to be a prior syntaxonomic synonym of *Hyparrhenietalia hirtae* Rivas-Mart. 1978 (nom. inval.). Instead, the choice of the alliance is a more complex question. *Hyparrhenion hirtae* and *Cymbopogono-Brachypodion ramosi* are both accepted in the Eurovegchecklist as geographically vicariant alliances, the first occurring in the western Mediterranean and the southern Regions of the central Mediterranean whereas the second being restricted to the eastern Mediterranean. In our opinion, the classification of the *Stipo austroitalicae-Hyparrhenietum* should be based on comparing the floristic-coenological characteristics of the sampled communities with the original diagnoses of the two aforementioned alliances. Accordingly, we noticed that our *Hyparrhenia hirta* grasslands are characterized by the simultaneous occurrence of two taxa (*Stipa austroitalica* and *Scorzonera villosa* subsp. *columnae*) belonging to the *Stipa pennata* s.l. and *Scorzonera villosa* s.l. collective taxa respectively. This is a typical feature of the eastern Adriatic Mediterranean steppe-like grasslands too, where the two taxa in issue are *Scorzonera villosa* subsp. *villosa* and *Stipa eriocaulis*. Moreover, in the *Stipo austroitalicae-Hyparrhenietum hirtae* occur East-European or amphi-Adriatic species (*Dasypyrum villosum*, *Charybdis pancration*, *Hippocrepis glauca*, *Melica transsylvanica*, *Thapsia garganica*, *Asyneuma limonifolium*, *Centaurea deusta*, *Ornitoghalum gussonei*) which are species not included in the *Hyparrhenion hirtae* range. For this reason, we classified the *Stipo austroitalicae-Hyparrhenietum* in the *Cymbopogono-Brachypodion ramosi*. However, considering that the above-mentioned differential species of *Stipo-Hyparrhenietum* are all belonging to classes other than *Lygeo-Stipetea*, a different framework could be hypothesized. In practice it would be a question of considering a single Mediterranean alliance for both "eastern" and "western" *Hyparrhenia hirta* communities and delegating possible biogeographic differentiation to the lower syntaxonomic ranks, such as suballiances or associations. This consideration would be also supported by the fact that the species which were originally considered as characteristic species of both *Cymbopogono-Brachypodion ramosi* and *Cymbopogono-Brachypodietalia ramosi* (*Allium sphaerocephalon*, *Briza maxima*, *Crucianella latifolia*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Medicago minima*, *Lagurus ovatus*, *Linum strictum* and *Lotus edulis*), display a wide Mediterranean distribution and do not suggest *Cymbopogono-Brachypodion ramosi* as an alliance restricted solely to the central-eastern Mediterranean. The situation does not change even adding the species considered by Horvatić (1973; 1975) as transgressive or ingressive in *Cymbopogono-Brachypodietalia ramosi* (e.g., *Allium subhirsutum*, *Bituminaria bituminosa*, *Carex divulsa*, *Clinopodium nepeta*, *Filago germanica*, *Hedypnois rhagadioloides*, *Hymenocarpos circinnatus*, *Lotus ornithopodioides*, *Oloptum miliaceum*, *Scorpiurus subvillosus*, *Trifolium angustifolium*, *Trifolium scabrum*). In fact, more than the list of characteristic species of *Cymbopogono-Brachypodion*, it was the great biogeographic selectivity of the characteristic species of the *Hyparrhenion hirtae* (see Diaz-Garretas and Asensi 1999) that discouraged *Hyparrhenion hirtae* to be used as syntaxonomic reference for our relevés. In addition to species occurring throughout the whole Mediterranean basin (e.g. *Andropogon distachyos*, *Hyparrhenia hirta*, *Heteropogon contortus*, *Bothriochloa ischaemum*, *Convolvulus althaeoides*), the *Hyparrhenion hirtae* exhibits its characteristic species which are strictly western Mediterranean (*Daucus crinitus* and *D. setifolius*) or species not occurring in the Adriatic area (*Aristida adscensionis*, *Carex depressa*, *Tricholaena teneriffae*), or not occurring in It-

Table 3. *Stipo austroitalicae-Hyparrhenietum hirtae* Biondi et Guerra 2008.

		Relevè number	1	2	3	4	5
		Altitude	300	310	315	280	290
		Aspect	WSW	W	SW	SSW	W
		Slope°	10	15	5	10	15
		Area m²	30	30	30	30	30
		Cover%	80	85	75	85	90
		Stipo austroitalicae-Hyparrhenietum hirtae					
endemic	H caesp	Stipa austroitalica subsp. austroitalica	2	1	+	+	1
		Cymbopogoni-Hyparrhenion & Hyparrhenietalia					
Eurasiat	H caesp	*Hyparrhenia hirta*	4	4	4	4	5
steno-Medit	T scap	*Briza maxima*	+	+	+	1	+
steno-Medit	T scap	*Linum strictum* subsp. *strictum*	+	1	1	.	+
Euro-Medit	H scap	*Bituminaria bituminosa*	1	2	2	.	.
Euro-Medit	T scap	*Lagurus ovatus* subsp. *ovatus*	2	+	.	.	.
steno-Medit	T scap	*Hedypnois rhagadioloides*	+	+	.	.	.
steno-Medit	T scap	*Lotus ornitopodioides*	.	.	1	+	.
Euro-Medit	T rept	*Trifolium scabrum* subsp. *scabrum*	+	1	.	.	.
		Lygeo-Stipetea					
Euro-Medit	T scap	*Avena barbata*	1	+	2	3	2
Euro-Medit	H scap	*Convolvulus cantabrica*	.	+	1	+	2
steno-Medit	G bulb	*Allium tenuiflorum*	.	.	+	2	2
steno-Medit	H scap	*Reichardia picroides*	+	1	.	+	.
steno-Medit	G bulb	*Charybdis pancration*	.	.	+	+	2
steno-Medit	H scap	*Thapsia garganica*	.	.	.	+	+
steno-Medit	H caesp	*Dactylis glomerata* subsp. *hispanica*	.	.	+	.	.
steno-Medit	T scap	*Lolium rigidum*	.	.	.	.	+
Euro-Medit	H caesp	*Melica ciliata*	.	.	.	+	.
		Stipo-Trachynietea					
steno-Medit	T scap	*Crupina crupinastrum*	1	1	+	+	+
steno-Medit	T scap	*Polygala monspeliaca*	+	+	2	1	+
steno-Medit	T scap	*Rostraria hispida*	1	+	+	+	+
Euro-Medit	P caesp	*Festuca danthonii* subsp. *danthonii*	+	+	+	+	+
Euro-Medit	H scap	*Urospermum dalechampii*	.	1	+	1	2
steno-Medit	T scap	*Hippocrepis ciliata*	+	1	+	.	.
steno-Medit	T scap	*Hypochoeris achyrophorus*	.	+	+	1	.
Euro-Medit	T scap	*Ononis reclinata*	+	1	.	.	+
steno-Medit	T scap	*Stipellula capensis*	1	+	+	.	.
Euro-Medit	T scap	*Coronilla scorpioides*	.	.	+	.	+
Euro-Medit	T scap	*Euphorbia falcata* subsp. *falcata*	.	.	.	+	+
Euro-Medit	T scap	*Helianthemum salicifolium*	.	.	1	+	.
steno-Medit	T scap	*Linum corymbulosum*	.	.	.	1	+
steno-Medit	T scap	*Stachys romana*	.	.	.	2	1
Eurasiat	T scap	*Centaurium tenuiflorum* subsp. *tenuiflorum*	.	.	.	.	+
steno-Medit	T scap	*Brachypodium distachyon*	.	.	.	.	+
Euro-Medit	T scap	*Trifolium stellatum*	.	.	+	.	.
Euro-Medit	T scap	*Trigonella monspeliaca*	.	.	.	+	.
Eurasiat	T scap	*Trifolium campestre*	.	.	.	+	+
		Festuco-Brometea & Molinio-Arrhenatheretea					
SE-Europ	G bulb	*Scorzonera villosa* subsp. *columnae*	1	2	2	+	1
steno-Medit	H scand	*Convolvulus elegantissimus*	+	+	1	+	.
steno-Medit	T scap	*Thapsia asclepium*	.	+	+	+	1
Euro-Medit	G bulb	*Anacamptis pyramidalis*	.	.	1	+	1
steno-Medit	T scap	*Anthyllis vulneraria* subsp. *rubriflora*	.	.	+	+	2
Eurasiat	H bien	*Centaurium erythraea* subsp. *erythraea*	.	+	+	+	.
SE-Europ	H caesp	*Hippocrepis glauca*	+	+	1	.	.
Euro-Medit	G bulb	*Allium vineale*	+	+	.	.	.
Euro-Medit	H scap	*Asyneuma limonifolium*	.	+	+	.	.
endemic	H bien	*Centaurea deusta*	.	.	1	.	+
Euro-Medit	H scap	*Eryngium campestre*	.	.	+	+	.
Euro-Medit	G bulb	*Anacamptis coriophora*	.	+	+	.	.
Eurasiat	H scap	*Poterium sanguisorba* subsp. *balearicum*	.	1	+	.	.
Euro-Medit	T scap	*Blackstonia perfoliata* subsp. *perfoliata*	.	.	.	+	1
Eurasiat	H bien	*Daucus carota*	.	+	.	.	.
Euro-Medit	G bulb	*Muscari comosum*	.	.	+	.	.
steno-Medit	G bulb	*Ornitoghalum gussonei*	.	.	+	.	.
steno-Medit	H bien	*Sixalix atropurpurea*	.	.	+	.	.
		Ononido-Rosmarinetea	.	.	.	.	.
steno-Medit	Ch suffr	*Teucrium capitatum* subsp. *capitatum*	1	1	+	+	1
steno-Medit	Ch suffr	*Micromeria graeca*	2	2	1	+	.
steno-Medit	P caesp	*Cistus creticus* subsp. *eriocephalus*	.	2	1	.	.
steno-Medit	Ch suffr	*Euphorbia spinosa*	.	.	.	1	+
endemic	Ch suffr	*Helianthemum jonium*	1	.	+	.	.
steno-Medit	H caesp	*Cistus salvifolius*	.	1	.	.	.

Table 3. Continuation.

		Relevè number	1	2	3	4	5
		Altitude	300	310	315	280	290
		Aspect	WSW	W	SW	SSW	W
		Slope°	10	15	5	10	15
		Area m²	30	30	30	30	30
		Cover%	80	85	75	85	90
steno-Medit	Ch suffr	*Fumana thymifolia*	+	.	.	.	.
Medit-mont	Ch suffr	*Satureja montana*	.	.	.	1	.
		Chenopodietea* & *Artemisietea					
Euro-Medit	T scap	*Bellardia trixago*	.	.	+	+	1
Euro-Medit	T scap	*Knautia integrifolia* subsp. *integrifolia*	2	.	+	1	.
Euro-Medit	T scap	*Nigella damascena*	.	.	+	1	1
Euro-Medit	T scap	*Helminthotheca echioides*	1	1	+	.	.
steno-Medit	T scap	*Anthemis arvensis* subsp. *incrassata*	1	.	.	+	.
steno-Medit	H scap	*Carlina corymbosa*	.	+	1	.	.
Euro-Medit	T scap	*Dasypyrum villosum*	2	.	.	+	.
steno-Medit	T scap	*Orlaya daucoides*	.	1	1	.	.
Euro-Medit	T scap	*Pallenis spinosa* subsp. *spinosa*	.	+	+	.	.
steno-Medit	T scap	*Triticum neglectum*	.	+	.	1	.
steno-Medit	T scap	*Ammoides pusilla*	.	.	+	.	.
Eurasiat	H bien	*Lactuca viminea* subsp. *viminea*	.	.	.	.	+
Euro-Medit	H scap	*Picris hieracioides* subsp. *hieracioides*	1	.	.	.	.
steno-Medit	T scap	*Reseda alba* subsp. *alba*	+	.	.	.	.
Eurasiat	H scap	*Silene vulgaris*	+	.	.	.	.
steno-Medit	T scap	*Linum decumbens*	+	.	.	.	.
steno-Medit	T scap	*Tyrimnus leucographus*	.	.	+	.	.
		***Quercetea ilicis* (*Pistacio-Rhamnetalia*)**					
steno-Medit	P caesp	*Pistacia lentiscus*	.	.	+	+	+
steno-Medit	P caesp	*Asparagus acutifolius*	+	.	.	+	.
steno-Medit	P caesp	*Daphne gnidium*	.	.	.	+	+
steno-Medit	P caesp	*Olea europaea* var. *sylvestris*	.	.	.	+	+
SE-Europ	P caesp	*Rhamnus saxatilis*	.	.	.	1	.
		Sedo-Scleranthetea					
Euro-Medit	H caesp	*Petrorhagia saxifraga* subsp. *gasparrinii*	+	.	.	.	+
Euro-Medit	T scap	*Reseda phyteuma* subsp. *phyteuma*	1	1	.	.	.
Euro-Medit	Ch succ	*Petrosedum ochroleucum* subsp. *mediterraneum*	+	.	.	.	.
		Poetea bulbosae					
Eurasiat	H caesp	*Poa bulbosa*	.	.	.	+	.

aly (*Eragrostis papposa*) or restricted to the coastal areas of northern Africa (*Dichanthium annulatum*, *Cenchrus ciliaris*, *Stipagrostis sahelica*, *Tetrapogon villosus*). Accordingly, the classification of *Stipo austroitalicae-Hyparrhenietum hirtae* in *Cymbopogono-Brachypodion ramosi* seemed the most logical choice. The phytosociological literature of the Italian Peninsula does not currently report any reference to *Cymbopogono-Brachypodion ramosi*. This alliance is not taken into consideration in Biondi et al. (2014) not even as a possible synonym of *Hyparrhenion hirtae*. In fact, references to this alliance are all coming from the coastal sectors of the Dinarids or from Albania (Hoda and Mersinllari 2000). However, it is possible that the *Thymo-Hyparrhenietum hirtae* described in Di Pietro et al. (2002) for the coastal sectors of southern Lazio, originally classified in the *Hyparrhenion hirtae*, could be moved in the *Cymbopogono-Brachypodion* by virtue of its successional and/or spatial link with eastern European potential forest vegetation types (Blasi and Di Pietro 1998).

MEDICAGO DISCIFORMIS-BRACHYPODIETUM DISTACHYI Biondi et Guerra 2008 (Table 4, rels 1–4)

This community shows a clear dominance of *Brachypodium distachyum* and characterizes small calcareous outcrops or preferential walking sites for animals within the perennial communities dominated by *Scorzonera villosa* subsp. *columnae*, *Stipa austroitalica* and *Hyparrhenia hirta*. Due to the few relevès carried out in this paper, it does not seem appropriate to promote a too deep syntaxonomic discussion. However, as already highlighted in the previous paragraph, the syntaxonomic classification of the Mediterranean therophytic communities in Italy still remains a heated point of debate (see Biondi et al. 1997; Di Pietro et al. 2002; Fanelli et al. 2010; Di Pietro et al. 2017). In this case we have decided to make reference to the *Medicago disciformis-Brachypodietum distachyi*, which was already described for the study area (Biondi and Guerra 2008). This association is probably the only therophytic association of the *Trachynietea distachyae* described in Italy displaying a clear dominance of *Brachypodium distachyum*. Precisely the dominance of *Brachypodium distachyon* suggested us to include this association in the *Trachynion distachyae*. Instead, Biondi and Guerra (2008) proposed to classify this association in the new alliance *Hypochaeridion achyrophori* Biondi & Guerra 2008, (eastern geo-vicariant of *Trachynion distachyae*) having the following characteristic species: *Hypochoeris achyrophorus*, *Ononis reclinata*, *Lotus ornithopodioides*,

Table 4. *Medicago disciformis-Brachypodietum distachyi* Biondi et Guerra 2008 (rels 1–4); *Lagurus ovatus* community (rels 5–6).

		Relevè number	1	2	3	4	5	6
		Altitude x 10	28	28	30	30	30	31
		Aspect	SW	SSW	.	.	.	.
		Slope°	3	3	.	.	.	.
		Area m²	2	2	2	2	2	2
		Cover%	90	85	85	85	80	85
		Medicago disciformis-Brachypodietum distachii						
T scap	steno-Medit	*Brachypodium distachyon*	**4**	**3**	**3**	**2**	.	.
T scap	steno-Medit	*Medicago disciformis*	+	.	+	.	.	.
		***Lagurus ovatus* & *Anisantha madritensis* comm.**						
T scap	Euro-Medit	*Lagurus ovatus* subsp. *ovatus*	.	.	+	+	**3**	**3**
T scap	Euro-Medit	*Anisantha madritensis*	.	.	+	+	**2**	**2**
		Brachypodion distachii						
T scap	steno-Medit	*Campanula erinus*	.	.	2	+	+	1
T scap	Euro-Medit	*Euphorbia exigua* subsp. *exigua*	+	+	+	.	+	.
T scap	Euro-Medit	*Bupleurum baldense*	1	+	.	.	.	.
T scap	Euro-Medit	*Ononis reclinata*	.	+	.	.	+	.
		Brachypodietalia distachyi*; *Stipo-Trachynietea						
T scap	steno-Medit	*Ononis ornithopodioides*	1	+	+	1	+	.
T rept	Euro-Medit	*Lysimachia foemina*	.	+	.	.	.	+
T scap	Euro-Medit	*Helianthemum salicifolium*	+	+	.	+	+	.
T scap	steno-Medit	*Hypochoeris achyrophorus*	1	.	+	.	+	+
T caesp	Euro-Medit	*Festuca danthonii* subsp. *danthonii*	+	1	+	.	+	.
T scap	Euro-Medit	*Filago pyramidata*	+	.	+	.	.	+
T scap	steno-Medit	*Linum strictum* subsp. *strictum*	2	2	+	.	.	.
T scap	steno-Medit	*Onobrychis caput-galli*	1	2	+	.	.	.
T rept	Euro-Medit	*Trifolium scabrum* subsp. *scabrum*	1	2	+	+	+	+
T scap	Euro-Medit	*Catapodium rigidum*	.	+	1	.	.	.
T scap	Eurasiat	*Centaurium tenuiflorum* subsp. *tenuiflorum*	1	+	.	.	.	.
T scap	Euro-Medit	*Cynosurus echinatus*	+	.	.	1	.	.
T rept	steno-Medit	*Filago asterisciflora*	1	1	.	.	.	.
T scap	steno-Medit	*Hippocrepis ciliata*	1	1	.	.	.	.
T scap	Euro-Medit	*Medicago minima*	1	1	.	.	.	.
T scap	steno-Medit	*Stachys romana*	+	+	.	.	.	.
T scap	steno-Medit	*Trifolium infamia-ponertii*	+	+	.	.	.	.
T scap	Euro-Medit	*Trifolium stellatum*	.	+	.	.	+	.
T caesp	Euro-Medit	*Festuca myuros* subsp. *myuros*	.	.	1	.	.	+
T scap	steno-Medit	*Briza maxima*	.	.	1	.	.	.
T scap	steno-Medit	*Crupina crupinastrum*	+	.	.	.	.	.
T rept	steno-Medit	*Filago pygmaea*	.	+	.	.	.	.
T scap	Euro-Medit	*Hippocrepis biflora*	.	.	.	.	.	+
T scap	steno-Medit	*Polygala monspeliaca*	.	+	.	.	.	.
T scap	Eurasiat	*Trifolium campestre*	+	.	.	.	.	.
T scap	steno-Medit	*Plantago lagopus*	+	1	.	.	.	.
T scap	Euro-Medit	*Crepis neglecta*	.	.	.	.	1	2
		Chenopodietea						
T scap	steno-Medit	*Lysimachia arvensis* subsp. *arvensis*	1	.	+	.	.	.
T scap	Euro-Medit	*Dasypyrum villosum*	.	+	.	+	.	.
T scap	steno-Medit	*Triticum neglectum*	2	2	.	.	.	.
T scap	Euro-Medit	*Carthamus lanatus*	.	.	.	.	+	.
T scap	Euro-Medit	*Plantago coronopus* subsp. *coronopus*	.	+	.	.	.	.
		Sedo-Scleranthetea						
T scap	steno-Medit	*Gastridium ventricosum*	.	+	.	.	.	.
H caesp	Euro-Medit	*Petrorhagia saxifraga* subsp. *gasparrinii*	.	+	.	.	.	.
CH succ	Euro-Medit.	*Petrosedum ochroleucum* subsp. *mediterraneum*	.	.	+	.	+	+
CH succ	Euro-Medit	*Sedum album*	+	.	.	.	.	.
T scap	steno-Medit	*Valantia muralis*	.	.	1	.	.	2
		Lygeo-Stipetea						
T scap	Euro-Medit	*Avena barbata*						
H scap	Euro-Medit	*Convolvulus cantabrica*	+	.	.	.	.	.
H scap	steno-Medit	*Thapsia garganica*	.	+	.	.	.	.
T par	Euro-Medit	*Cuscuta planiflora*	.	+	.	.	.	.
		Poetea bulbosae						
H caesp	Eurasiat	*Poa bulbosa*	1	1	.	.	.	+
		Festuco-Brometea						
H caesp	endemic	*Koeleria splendens*	.	+	.	.	.	.
		Ononido-Rosmarinetea						
CH suffr	steno-Medit	*Teucrium capitatum* subsp. *capitatum*	+	+	.	.	.	.
CH rept	SE-Europ	*Thymus spinulosus*	1	1	.	.	.	.
CH suffr	steno-Medit	*Fumana thymifolia*	1	.	.	.	.	.

Coronilla scorpioides. In particular, the therophitic communities of the Murgia hills were included in the suballiance *Ononidenion ornithopodioidis* Biondi & Guerra 2008 whose differential species were selected in *Ononis ornithopodioides*, *Trifolium lucanicum*, *Bromus fasciculatus*, *Odontites lutea*, *Ammoides pusilla*, *Romulea bulbocodium* and *Convolvulus elegantissimus*. In our opinion, the whole characteristic component of the *Hypochaeridion achyrophori* does not identify any geographical peculiarity since all the characteristic species display a wide Mediterranean distribution. Accordingly, we don't think there is any reason to distinguish floristically and biogeographically *Hypochaeridion achyrophori* from the *Trachynion distachyae*. According to Mucina et al. (2016) the *Hypochaeridion achyrophori*, as well as being invalid, is to be considered a syntaxonomic synonym of *Vulpio ciliatae-Crepidion neglectae* Poldini 1989. Where small depressions are formed on the limestone crust with greater soil coverage, especially in areas where the passage of grazing animals is more frequent, annual species with slightly more anthropogenic character, such as *Anisantha madritensis* and *Lagurus ovatus* take over as dominant (Table 4, rels 5–6). In syntaxonomic terms, these communities can be interpreted as the transition between *Brachypodietalia distachyi* and *Brometalia rubenti-tectorum* (*Chenopodietea*).

PETROSEDUM OCHROLEUCUM SUBSP. *MEDITERRANEUM* community (Table 5)

In environmental situations of undulating rocky outcrops characterized by micro-depressions in the calcareous plateau profile, communities with a clear dominance of *Petrosedum ochroleucum* subsp. *mediterraneum* accompanied by a few other chamaephytes and a rich therophytic component are found. The degree of vegetation cover is quite high as there are very few parts of the sampling plots not covered by a thin layer of soil at least. From a syntaxonomic point of view, the coenological role of *Petrosedum ochroleucum* was already known in the study area, this taxon being one of the guide species of the association *Sedo ochroleuci-Saturejetum cuneifoliae* already described for the small-size terraces bordering the Gravina gorges (Di Pietro and Misano 2010). However, this reference cannot be used for our relevés the habitat type of the *Sedo-Saturejetum cuneifoliae* being quite different and *Satureja cuneifolia* being completely absent in our relevés. In the Italian peninsula, other communities dominated by species belonging to the genus *Petrosedum* have already been described, such as the *Sedetum rupestris-sexangularis* Di Pietro et al. 2006 of the Prenestini mountains in the Lazio region pre-Apennines (Di Pietro et al. 2006) and the *Linario purpureae-Petrosedetum rupestris* Ciaschetti et al. 2020 of the hilly and lower-montane belts of the Abruzzo

Table 5. *Petrosedum ochroleucum* community.

		Relevè number	1	2	3	4	5
		Altitude	300	310	315	300	295
		Aspect	.	.	.	.	.
		Slope°	.	.	.	.	.
		Area m²	2	2	2	2	2
		Cover%	85	90	85	80	85
		***Petrosedum mediterraneum* community**					
Euro-Medit	CH succ	*Petrosedum ochroleucum* subsp. *mediterraneum*	5	5	5	5	5
		Sedo-Scleranthetea					
steno-Medit	T scap	*Campanula erinus*	.	.	+	.	.
Euro-Medit	T scap	*Linaria simplex*	.	+	.	.	.
steno-Medit	T scap	*Valantia muralis*	.	.	.	1	.
		Stipo-Trachynietea					
Euro-Medit	T scap	*Bromus madritensis*	.	1	1	+	+
SE-Europ	T scap	*Crupina vulgaris*	.	.	+	+	+
Euro-Medit	T rept	*Lysimachia foemina*	+	.	.	.	+
steno-Medit	T scap	*Briza maxima*	.	+	+	.	.
Euro-Medit	T scap	*Catapodium rigidum*	.	+	+	.	.
steno-Medit	T scap	*Hypochoeris achyrophorus*	.	.	+	+	.
steno-Medit	T scap	*Brachypodium distachyon*	1	.	1	.	.
steno-Medit	T scap	*Hedypnois rhagadioloides*	.	.	.	+	.
Euro-Medit	T scap	*Helianthemum salicifolium*	.	.	.	.	1
Euro-Medit	T scap	*Hippocrepis biflora*	.	.	.	.	+
steno-Medit	T scap	*Linum strictum* subsp. *strictum*	.	.	+	.	.
Euro-Medit	T scap	*Ononis reclinata*	.	.	.	.	+
steno-Medit	T scap	*Plantago lagopus*	+	.	.	.	.
Euro-Medit	T caesp	Festuca danthonii subsp. danthonii	.	.	.	+	.
Euro-Medit	T caesp	*Festuca myuros* subsp. *myuros*	+	.	.	.	.
Euro-Medit	T scap	*Lagurus ovatus* subsp. *ovatus*	+	.	.	+	+
		Ononido-Rosmarinetea					
steno-Medit	CH suffr	*Fumana ericifolia*	1	1	2	.	.
Endem	CH suffr	*Helianthemum jonium*	+	.	.	1	+
		Poetea bulbosae					
paleotemp.	H caesp	*Poa bulbosa*	+	+	.	1	1

Apennines (Ciaschetti et al. 2020). However, both these communities have different guide species (e.g., *Petrosedum rupestris*) and exhibit quite different floristic compositions compared with those of the Apulian communities. A suitable syntaxonomic reference already published not being available and our relevés being too few to propose a new association, we preferred to preliminary name this community simply as *Petrosedum ochroleucum* subsp. *mediterraneum* comm. In terms of higher synatxonomical ranks, the most plausible references are *Alysso-Sedion*, *Alysso-Sedetalia* and *Sedo-Scleranthetea*.

Conclusions

In this paper, two new associations were identified and described for the south-eastern sector of Peninsular Italy, namely the xerophytic annual grasslands and micro-garrigues dominated by *Atractylis cancellata* and *Micromeria microphylla*. These taxa are two S-Mediterranean species whose Italian distribution is restricted to southern Italy and for which very scarce phytosociological references were available. Moreover, new phytosociological data and syntaxonomical insights were provided on other types of Mediterranean dry grasslands and micro-garrigues, identified in the study area. The new association *Campanulo erini-Micromerietum microphyllae* was classified in the class *Stipo-Trachynietea* this choice representing a novelty for the communities dominated by *Micromeria microphylla*, for which the only references available at present were the classes *Parietarietea judaicae* and *Asplenietea trichomanis*. The new association *Lysymachio foeminae-Atractylidetum cancellatae* was here classified in the alliance *Onobrychido-Ptilostemonion stellati* (that we moved from *Stipo-Bupleretalia semicompositi* to *Brachypodietalia distachyi*). This alliance susbstitutes the W-Mediterranean *Stipion retortae* and the S-Mediterranean *Atractylido-Stipion retortae* in encompassing the most xerothermic fringe of the order *Brachypodietalia distachyi* in southern Italy. At the same time, we have still considered the occurrence of *Trachynion distachyae* in our study area classifying in this alliance the association *Medicago disciformis-Brachypodietum distachyi*. In our opinion, in southern Italy there is an overlap between the ephemeral communities of the Meso-Mediterranean belt coming from the coastal sectors of central-northern Italy and those of the dry-Thermo-Mediterranean belt coming from the pre-desert areas of the south-eastern Mediterranean. For this reason the identification and separation of two different alliances (*Trachynion distachyae* and *Onobrychido-Ptilostemonion stellati*) in the study area was not easy as these two alliances shared a large part of their therophytic component. As a useful tool for classification we reiterated the diagnostic importance expressed by the guide species (dominant species) of a community. In our opinion, the physiognomical dominance of a given species should not exclusively to be interpreted as the response to the current environmental conditions but also as the result of previous epiontological processes. For this reason, the dominant species should express a syntaxonomical diagnostic power (especially when the syntaxonomic debate is about the choice of order or class) greater than what would be assigned to it based on its mere presence in the community. In our specific case of the *Lysimachio-Atractylidetum cancellatae*, the dominance of *Atractylis cancellata* was considered as the sign of previous occurrences of a xerothermic Irano-Turanian pre-desertic vegetation that migrated in southern Europe from the Messinian Age on. This interpretation is in accordance with the spatial contact of *Lysimachio-Atractylidetum cancellatae* with the perennial *Lygeum spartum* or *Hyparrhenia hirta* communities and with successional stages tending to potential vegetation types belonging to *Pistacio-Rhamnetalia alaterni*. Our syntaxonomical choices, however, cannot solve the problem the floristic similarities between the *Onobrychido-Ptilostemonion stellati* and the *Trachynion distachyae*. In fact, despite being alliances belonging to two different orders, they share a large part of their characteristic species. Accordingly, we will address the resolution of this syntaxonomic question for future researches to be carried out using a much larger amount of phytosociological data from the entire Mediterranean basin. Basing on biogeographic and nomenclatural reasons, the association *Stipo austroitalicae-Hyparrhenietum hirtae* was classified in the *Cymbopogono-Brachypodietalia ramosi* and *Cymbopogono-Brachypodion ramosi* although the floristic and ecological boundaries between the latter alliance and the W-Mediterranean alliance *Hyparrhenion hirtae* still remain undefined.

Some points of discussion raised in this paper turned out to be only partially in agreement with the frameworks provided by both the Vegetation Prodrome of Italy (Biondi et al. 2014) and the Eurovegchecklist (Mucina et al. 2016) leaving open the way to possible proposals for syntaxonomic changes in the future.

Syntaxonomic scheme

STIPO-TRACHYNIETEA DISTACHYAE Brullo in Brullo et al. 2001
BRACHYPODIETALIA DISTACHYI Rivas-Mart. 1978
[= *Trachynietalia distachyae* Rivas-Mart. 1978 nom. mut. propos.; *Stipo-Bupleuretalia semicompositi* Brullo in Brullo et al. 2001 synt. syn. p.p.]
Trachynion distachyae Rivas-Mart. 1978
Medicago disciformis-Brachypodietum distachyi Biondi et Guerra 2008
Lagurus ovatus and *Anisantha madritensis* comm.
Onobrychido-Ptilostemonion stellati Brullo et al. 2001
Lysimachio foeminae-Atractylidetum cancellatae ass. nova
Campanulo erini-Micromerietum microphylli ass nova
SEDO-SCLERANTHETEA Br.-Bl. 1955
ALYSSO-SEDETALIA Moravec 1967
Alysso alyssoidis-Sedion Oberd. et T. Müller in T. Müller 1961
Petrosedum ochroleucum subsp. *mediterraneum* community

LYGEO SPARTI-STIPETEA TENACISSIMAE Rivas-Mart.1978
CYMBOPOGONO-BRACHYPODIETALIA RAMOSI Horvatić 1963
Cymbopogono-Brachypodion ramosi Horvatić 1963
Stipo austroitalicae-Hyparrhenietum hirtae Biondi et Guerra 2008

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Appendix - Place and date of samples

Table 1 - *Lysimachio foeminae-Atractylidetum cancellatae*. Rels 1–4: Loc. S. Arcangelo road towards Senise 24/07/2001; rels 5–7: Madonna delle Grazie (Pisticci) 28/04/2001; rel. 8: Calanchi di Aliano 18/05/2001; rels 9–16: loc. Cozzica (Matera - Basilicata) 25/05/2002.

Table 2 - *Campanulo erini-Micromerietum microphyllae*. Rels 1–14: surroundings of Masseria Accetta Grande (a site located between the city of Taranto and the towns of Statte and Massafra) 01/05/2018.

Table 3 - *Stipo-Hyparrhenietum hirtae*. Rels 1–5: Gravina di Laterza. Site of Villa Ceglie and surrounding areas 18/05/2008 (Laterza - Puglia).

Table 4 - *Medicago disciformis-Brachypodietum distachyi*. Rels 1–2: Gravina di Laterza 19/05/2001; rels 3–6: Calcarenite quarries between Laterza and Matera 03/05/2002.

Table 5 - *Petrosedum ochroleucum* subsp. *mediterraneum* community. Rels 1–5: Calcarenite quarries between Laterza and Matera 03/05/2002.